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CONTENTS.

ILLUSTRATED ARTICLES: PAGE.
The Manufacture of Storage Batteries 289
Economical Electrical Distribution 291
A New Iron Frame Bell 292
Sir William Thomson's New Electric Measuring Instruments 293
A Novel Form of Armature for Electro Magnets 293
The Correction Factor of a Galvanometer Coil when the Needle is Displaced along the Axis 294

BOOK REVIEWS:
"Practical Electricity." 288

CORRESPONDENCE:
What is Invention? 290
Tests of Insulated Wires 290
Horizontal Intensity of the Earth's Magnetism 292
The Direction of Current in a Battery 292

PAGE
EDITORIAL PARAGRAPHS 287

MISCELLANEOUS:
The House Fund of the American Institute of Electrical Engineers 288
Western Union Figures 292
Effects of Magnetism on Strength of Iron and Steel 292
A Report on Wire Gauge . 295
The National Electric Light Association 295

DEPARTMENTS:
New York Notes 295
New England Notes 296
Philadelphia Notes 296
Pennsylvania Notes 296
Western Notes 297
The Telegraph 297
The Telephone 297
The Electric Light 297
Applications of Power 297
Personals 298
Miscellaneous Notes 298
Stock Quotations 298
Business Notices 298
Our Illustrated Record of Electrical Patents 298

New Advertisements.

PAGE.
Empire China Works—Porcelain Electrical Supplies i
E. L. Post & Co.—Post's Zero Babbitt Metal i
The National Electric Light Association—Notice of Semi-Annual Meeting ix
Norman Hubbard—The Packard Vacuum Pumps ix
Franklin Electric Works—Pocket Medical Batteries, etc x
Hazazer & Stanley—Lock Seam Speaking Tubes, Annunciators, Electric Bells, etc xii
W. J. Johnston—Three New Books xiii
Want and For Sale Advertisements ix

Vol. IX. NEW YORK, JUNE 18, 1887. No. 25.

WE note that the recent fire and large loss of life at the Opera Comique Theatre, Paris, caused by a gas jet, has led to a demand for the electric light. This is natural, electric lighting being, with the most ordinary care, by far the safest means of illumination known. But quite outside of its superior safety, it has many recommendations for use in theatres and like buildings.

IT will be observed from the quarterly report, elsewhere printed, that the Western Union Company is once more among the dividend payers. Great as is the body of stock, it is not greater than the earning capacity of the vast organization of telegraph interests known as Western Union, and though the misfortunes of the company do not evoke sympathy, there will be many persons glad to see it on a dividend basis again.

THE intention of the English electricians in this country to celebrate next Monday, as announced in another column, the jubilee of the accession of Queen Victoria and the establishment of the electric telegraph in England, is excellent. It is somewhat singular that such a gathering of Britons has never been held before here, but the occasion is now happily chosen, and there is no doubt that the evening to be spent in the way proposed will be most enjoyable.

JUDGING from the reports as to the manner in which applications are beginning to come in for space at the forthcoming Electrical Exhibition of the American Institute, the display next fall will be a very large and representative one. A number of new things in the line of electric lighting and electric motive power will there be exhibited for the first time, so that not only electricians but the general public will find ample material for inspection, study and reflection.

THE recent attempt at Washington to float a company for telephonic work in Venezuela has attracted very general attention for various reasons. The boldness of the organizers, and their apparent reliance on the ignorance of the public, are the more striking when it is borne in mind that the exclusive concession for telephonic rights in Venezuela has already been made to the Inter-Continental Telephone Company of Boston. We have now in our hands a copy of the *Official Gazette* of Venezuela, of Nov. 5, 1883, setting forth the terms of the concession granted in June of that year.

THE descriptions and illustration of a fully equipped factory for the manufacture of storage batteries, which appear elsewhere, will give the reader a fair idea of the magnitude to which this new industry has grown among us within a year, and almost unperceived. The experience already gained has afforded ample precept upon which to lay out and execute work of this nature, and, as described, everything that can contribute to excellence and uniformity of product has been provided for. The manufacture of storage batteries is becoming one of the new great industries of the country.

IN another column Prof. Webb takes up a question of particular interest at this time, viz., the most economical method of distribution and the minimum weight of conductor. He discusses the question from the mathematical standpoint, which is certainly the most exact, but our non-mathematical readers will find in the general formulæ and the graphic methods developed from them much that will be of interest. It is only, indeed, when mathematical analysis is brought to bear upon such subjects that definite results can be obtained. And while empiricism may, and often does, lead the way, it finally takes its true place as an aid to the more refined and exact mathematical treatment.

IT seems that, notwithstanding the many attempts to devise a perfect safety lamp for miners, there still remains something to be accomplished in that direction. It will be remembered that not long since Mr. Ellis Lever, of Manchester, Eng., offered a prize of £500 for the production of a perfect portable electric miner's lamp. The lamps submitted did not come up to the requirements and the prize was not awarded. The recent terrible colliery explosions in England have, however, induced Mr. Lever to renew his offer for the production of such a lamp within the jubilee year. We think that American genius and skill might well be applied to this problem, as, aside from the good work to be accomplished, the prize is well worth striving for.

THE statement was recently hazarded by one of the New York daily papers that the use of the electric light was not advancing in this city, but that the number of electrics in use to-day is less than the number in use two or three years ago. This absurd assertion has now been copied as an item of fact by technical journals that should know better. It is a little difficult to get at exact figures, because the increase in street lights and in number of isolated arc and incandescent plants has been so large, but the total of lights to day is estimated by those conversant with the facts to be between 200 and 300 per cent. greater than it was in 1884–'5. Speaking from our personal knowledge, we may say that we are not aware of the discontinuance of any large or even small plant, while we have seen enlargements in scores of instances. Besides, not a single new building of any size is without electric lights. We would recommend anybody who thinks there are fewer electrics to take a sample walk down Broadway, from the Post-office to the Battery. Let him go into the buildings and look into the stores and find out how long the electric lights he sees there have been installed. He will at once get at statistics of amazing development. Moreover, the new work now laid out, for which the capital is in hand, will add scores of thousands of incandescent lights to those burning at present.

THE recent numerous earthquakes in different parts of the globe bring forward prominently the question whether electricity can be looked upon as the cause of such disturbances; or whether, on the contrary, it is a result of such action. According to the well known authority, Prof. John Milne, of Japan, an earth current may always be looked for as the result of an earthquake. A curious demonstration of this was brought out by facts which are now under careful investigation by the French military authorities. It seems that at the instant of one of the shocks in the recent disturbance in the Riviera, a telegraph operator while at the key was thrown from his seat and received a severe electric shock through both arms and across the chest. A very high potential must have been required to produce such an effect through a circuit of such high resistance as that presented by the human body. The incident is well worthy of further investigation, as it may show that enormous potentials are developed within the earth which, spread over a large area, may possibly be the cause of the earthquake disturbances.

IT has long been recognized that the employment of permanent magnets in measuring instruments designed for every day use is open to several objections. The strength of the magnets changes in time, and they are affected not only by adjacent objects, but by the currents circulating around them. Hence they require frequent calibration. These defects have been sought to be obviated by the use of springs as the opposing force. The springs however, are also open to the objection of inconstancy, though perhaps not in the same degree as the magnets themselves. The ideal measuring instrument is one evidently in which the opposing force is practically constant at all times, and probably the only force of that nature which could be readily applied is gravity. Although varying slightly in magnitude at different points, the difference between the greatest and least values, that is, between pole and equator, is $\frac{1}{189}$ of the mean, while within the temperate zones the difference is almost negligible. With gravity as the standard of comparison, Sir Wm. Thomson has constructed a series of measuring instruments graded to a large range of action. The principle of construction is based on the attraction which is manifested between parallel conductors carrying currents. The idea thus embodied is not new, but the difficulty heretofore experienced in leading the current to the coils has usually impaired the delicacy of the balance arrangement. This seems to have been overcome in Sir Wm. Thomson's instruments by the employment of a torsional balance.

THE fearful loss of life caused by the destruction of the Opera Comique in Paris was undoubtedly due in part to the fact that a panic was created by the theatre being in total darkness. The gas after starting the fire had either gone out or been turned out. Had the electric light been in use it is safe to say no such disaster could have happened. In support of this the manager of one of the London theatres tells how, during one of the recent performances, one of the gas bags used in connection with the lime light exploded, the concussion being sufficiently great to put ou the gas in the auditorium. All confusion, anxiety or panic was, however, averted owing to the electric light being in use throughout the theatre, for, simultaneously with the explosion, the lights not used during the performance were switched on before the audience could realize what had occurred. The manager went to the footlights, explained what had happened, and ordered the iron curtain to be lowered. Every one remained seated, and the performance was continued after some 10 or 15 minutes' delay. Without the electric light to fall back on, a panic might easily have been started, but thanks to the presence of the electrics no disturbance occurred. It goes without saying that the lime light, requiring gas, has been dispensed with at this theatre and the arc light substituted in its place, so that there can be no further cause for accident from that source.

IN view of the fierce attacks sometimes made on valuable patents, it is well to remember that they represent a monopoly of but limited duration, and that their very value lies in the economy that they effect in some way for the people who use them. The use of a patented article is in every instance, we believe, a matter of deliberate choice as to a convenience, and not the resort to an absolute necessity. The other side of the "monopolies" is rather neatly brought out in the following from the Omaha *Bee*: "A displeased correspondent of the New York *World* wrote to that paper and asked it to answer, if it could, 'what unpatented American industry is a monopoly in this country?' That journal referred him to the oil and coal industries. If the correspondent wants further information let him come West—come to Nebraska, and gaze upon the workings of both patented and unpatented monopoly industries. We can show him where railroad companies not only own coal mines, but where they fix a price that is beyond all reason and make the same price within one hundred miles of the mines the same as they charge four hundred miles further East. We can show him where unpatented lime is owned and handled exclusively by one railroad company and peddled all over the State at the same price—distance making no difference. We can show him where salt from great salt works is sold in the same manner. We can show him how unpatented dealers get special inducements, and how outrageous freights are charged on unpatented railroads. We could show him 'unpatented American industries which are monopolies,' by reason of the aggressions of great corporations, until his eyes would water and he would gasp for breath." After all, the inventor who arrives at great results by years of patient toil and the exercise of his unique talent is a very creditable monopolist, and we wish there were more of his kind. It sometimes happens, too, that large fortunes are acquired by those who obtain an interest in his inventions, but there is little to deplore in that, for they can only grow rich out of the greater economy effected in some special device for public benefit or by some improvement in manufacture.

NEW BOOKS.

PRACTICAL ELECTRICITY: BASED ON THE PRACTICAL DEFINITIONS OF THE ELECTRICAL UNITS. By W. E. Ayrton, F.R.S. Cassell & Co.: New York. 1887. 5 × 7½. Cloth, 516 pp. Price, $2.50.

It is stated on the title page that this excellent work is intended for use as a laboratory and lecture course for first year students of electrical engineering. After perusing the book, the reader is struck with the thought that the student who masters its contents in the appointed season will have a very easy time of it during the remaining years of his course. Not that the scope of the work is so broad as to cover most of the field of electrical engineering—on the contrary, it is so limited that the much paraphrased title is hardly sufficiently precise—but rather because of the fact that from the beginning the student is placed on such familiar terms with the various electrical phenomena, which electricity *is*, so far as we can divine it, that he can never afterward easily get wrong impressions regarding it. Once familiar with its phenomena and the means of detecting them, and measuring their intensity and volume, and the clear comprehension of any practical, which is to say useful, applications of electricity, becomes only a matter of simple inspection, while the relative values of such applications may be easily determined by the intelligent use of such a precise knowledge of principles as this book aims to impart. To teach thoroughly in the experimental manner of Faraday has been Professor Ayrton's design, and most admirably has he executed it.

The preface to *Practical Electricity* is an instructive essay on the art of teaching, and presents the author's views on that subject in a manner which proves them to be quite in harmony with the principles advocated by Huxley and Spencer. He says therein, for example, that in following what appears to him to be the *natural*, as distinguished from the *scholastic* method of studying electricity, he has treated the subject *analytically* rather than synthetically, because that race of successful experimental philosophers—children—adopt this method.

The arrangement of the contents of the book is admirable and altogether original. The subject of current is treated of in the first chapter, and its various properties described and illustrated; thus in the first figure a battery is shown passing a current through a simple tangent galvanometer, and deflecting a magnetic needle; then passing on through an electro-magnet and attracting an iron armature; then through a gas voltameter and decomposing a liquid; then through an electrolytic cell and decomposing metallic salts; and lastly through a calorimeter and heating a metallic wire. Thus at the beginning of his studies the student is shown the electric current exhibiting all of its properties (excepting the little-known physiological ones), while at the same time it is explained that the deflection of the needle, the attraction of the armature, the gas liberated, the metal deposited and the heat generated, are each and all a direct measure of the intensity or strength of the current. Once familiar with these phenomena of the electric current by which it may be known and measured, the varying degrees of ease with which accuracy may be attained by the different methods are pointed out, and the ampère is finally defined in terms of the quantity of silver deposited in unit time by the voltameter as being at the same time the simplest and most accurate method. The student is then led at once, in the second chapter, to the consideration of galvanometers and some general remarks on their calibration. The principles underlying the actions of the sine and tangent galvanometers are illustrated by very effective and ingenious mechanical devices, which will make clear to the minds of many readers the peculiar characteristics of these very useful instruments. The best proportions for needles and coils are explained, as well as a method of constructing galvanometers with permanent and electro-magnets in which the angular deflection is proportional to the current.

Difference of potentials, electrical quantity, density and their measurement are treated in a very novel fashion in the third chapter. To the student, perhaps, no property of the electric current is so difficult of conception as that of pressure. The old way of speaking of all differences of potential as electromotive force was confusing, and the author has taken special care in this chapter to avoid ambiguity. Electroscopes, electrometers and methods of measuring static potential and quantity are described so simply, and the construction and manipulation of the apparatus shown to be such an easy matter, that the reader is led to conclude, after all, that the electrometer is nearly as simple and useful an instrument as the galvanometer. In this very proper, though unusual, place, the student is told why rubbing electrifies, and for the first time in an elementary text-book, so far as my knowledge extends, the part played by friction in so-called frictional electricity is happily explained. The volt is here very prettily defined without reference to resistance—which has not yet been touched upon because, logically, we ought to know something about our force before investigating the nature of the resistance it will encounter, by showing that two conductors at different potentials act inductively upon one another and that, in consequence, there will be an attractive force tending to make the bodies approach each other, so that when the plates have certain dimensions a difference of potential of one volt would produce an attraction of so many grammes. This is certainly a happy definition for the student; for although electrical resistance is hard to comprehend, being so different from our notions of mechanical resistance, its unit is the only one legally defined, and is therefore usually placed first in order, and the volt and ampère defined with reference to it. The functions of and best proportions for magnetic screens—an important but neglected subject—are also described in this chapter, which ends with a few paragraphs on potential galvanometers and voltmeters.

The fourth chapter, which is devoted to resistance and its measurement, opens with an excellent proof of Ohm's law. The volt and ohm are practically defined, and the best methods of comparing and measuring resistance are explained, while very practical and complete instructions are given for the construction of resistance coils. The variation of resistance with material, dimensions and temperature are fully described, and the properties of various alloys mentioned. In this portion of the work is to be found Matthiessen's table of the specific resistances of the metals and alloys, with the usual indefinite reference to German silver. Why is it that the proportions of the constituents of this very important alloy are never given, while for every other alloy they are very carefully enumerated? Reference is also made to the new alloy called *platinoid*, consisting of "German silver" with one or two per cent. of metallic tungsten added, and the belief is expressed that this alloy will supersede both German silver and platinum silver for resistance coils, on account of its high specific resistance and small temperature correction. In regard to this statement it may be well to remind the reader that the results of a series of experiments made by Mr. Edward Weston have been published, which seem to prove conclusively that the addition of tungsten to any ordinary German silver alloy has, practically, no effect on either its resistance or temperature coefficient, and that the values obtained by Mr. Bottomley were probably due to a high percentage of nickel in the alloy with which he experimented.

"Current Generators" is the comprehensive heading to the fifth chapter, but with the exception of a brief reference to the principles underlying the action of accumulators, dynamos and thermopiles, the chapter is devoted to a very practical description of the several primary batteries in more common use, showing the chemical reactions which take place therein and the advantages peculiar to each. The various methods of comparing and measuring the electromotive force and resistance of batteries and other current generators, and the arranging of cells to produce given results, are concisely explained. The construction of constant total current shunts—an important detail in precise measurements—is also very fully described.

The sixth chapter deals with the subject of insulation. The laws of surface leakage and leakage through the mass are clearly set forth, and some of the principles of cable testing explained. Great stress is laid upon the necessity for good insulation in all parts of electrical measuring apparatus; a matter sometimes overlooked. Some sensitive galvanometers are also described, and several neat methods of determining their constants and measuring high resistances illustrated.

Perhaps the most novel and certainly one of the most interesting and instructive chapters in the book is the seventh, which embraces electrical quantity and capacity. The advantages of the ballistic galvanometer are set forth at length and the various corrections for the throw of the needle more fully described than is usual in elementary text books. The principles governing the capacity of condensers of plain and cylindrical surfaces are very clearly explained, and the unit of capacity, the farad, is defined in a very simple manner. Specific inductive capacity and its measurement receive a good deal of attention, and the intimate relations existing between the various statical units are brought clearly to mind, as, for example, in the defining of charge in terms of capacity. Many novel and useful practical tests with the condenser, such as measuring the resistance of a current generator, are given; and lest any misapprehension of the function of this useful instrument should beset the student, a demonstration is made to show that condensers are storers of electric energy, not of electricity. The measurement of large potential differences, insulation by rate of loss of charge, the calibration of electroscopes and the multiplying power of shunts used in measuring a discharge, together with other important details of static measurements which have been seldom touched upon by book writers in the past, are here described with all necessary minuteness. In fact, the reader is astonished at the amount of condensed and important information which is to be met with on almost every page. A lucid description of the electrophorus and other accumulating influence machines concludes the chapter, although, according to revered custom, this *should have* followed a description of the wonderful properties of amber, which *should have* opened the book.

To men practically engaged in heavy electrical engineering the eighth chapter will prove a boon, and will save the editors of technical journals the answering of many questions; while the student, through its means, will be able to commence his commercial career with information which those now in the business have spent much time in acquiring. This chapter is devoted to the subject of commercial ammeters and voltmeters; their calibration, use and the qualifications essential for a reliable instrument. The silver voltameter, the Fleming-Daniell and the Clark mercury cells—indispensable for accurate work—are described and illustrated, and their numerical constants, according to the best and latest authorities, given. Many tests and corrections for most possible errors are also given, and the subject is thoroughly and practically ventilated. The writer having in his work paid considerable attention to this subject, and having written in the same strain, is convinced that Prof. Ayrton has handled it as only a thorough experimentalist could.

The ninth and concluding chapter, devoted to power and its measurement, is a fitting continuation to the preceding one. The calculating of electric energy and power, the efficiency of electrical generators, and photometric measurements are simply, and like everything else in the book, clearly, explained. The appendix contains additional matter on derived or shunt circuits, and some specimen "instructions for experiments," as issued to the students at the City and Guilds of London Institute.

As already noted, the arrangement of the contents of the book is novel, but it is evidently the outcome of experiments carried out in logical order. Numerous practical examples follow each subject, and, wherever advisable, foot notes amplify the text. The volume is well illustrated by entirely new cuts, and all values are given in legal units. To the practitioner as well as to the student, the book will prove invaluable, and both will await impatiently the appearance of its companion volume on "Practical Magnetism," which Professor Ayrton has promised.

GEO. B. PRESCOTT, JR.

WESTON LABORATORY, NEWARK, N. J.

House Fund of the American Institute of Electrical Engineers.

We publish below the list of subscriptions to the House Fund of the American Institute of Electrical Engineers to June 14:

LIST OF CONTRIBUTIONS.

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Edward Weston	250
Total to June 14	$4,370

The London *Electrician* says:

We are very pleased to learn that a movement has been set on foot among the electrical community in the United States, which has for its object "to place the American Institute of Electrical Engineers on a firm and enduring basis," and to obtain for the institute a position in the scientific world such as that enjoyed by similar bodies on this side of the water. A further object of the movement is to obtain funds to build a house for the institute. These objects will undoubtedly have the warmest sympathy of the scientific and engineering professions in our own country. From a letter which we have received from two members of the council (Mr. Geo. M. Phelps, Jr., editor of *The Electrician and Electrical Engineer*, of New York, and Mr. T. C. Martin, of THE ELECTRICAL WORLD) we learn further that, although the movement has only recently taken shape after three years' talk, the sum of $4,000 has already been contributed, and—though this is not specifically stated—we have no doubt that any contributions which our readers might be disposed to offer as a token of good will would be highly appreciated, irrespective of the actual amount.

The Manufacture of Storage Batteries.

If one is to form an opinion as to the stage of development or perfection reached in an industry, it is only necessary for him to enter the workshops in which this particular industry is carried on. He will then be able to judge for himself whether the art has been reduced to exact rule as one of permanent practice, or whether it is still in the early, rude and experimental stage. One of the newest electrical industries to spring up in this country is the manufacture of storage batteries.

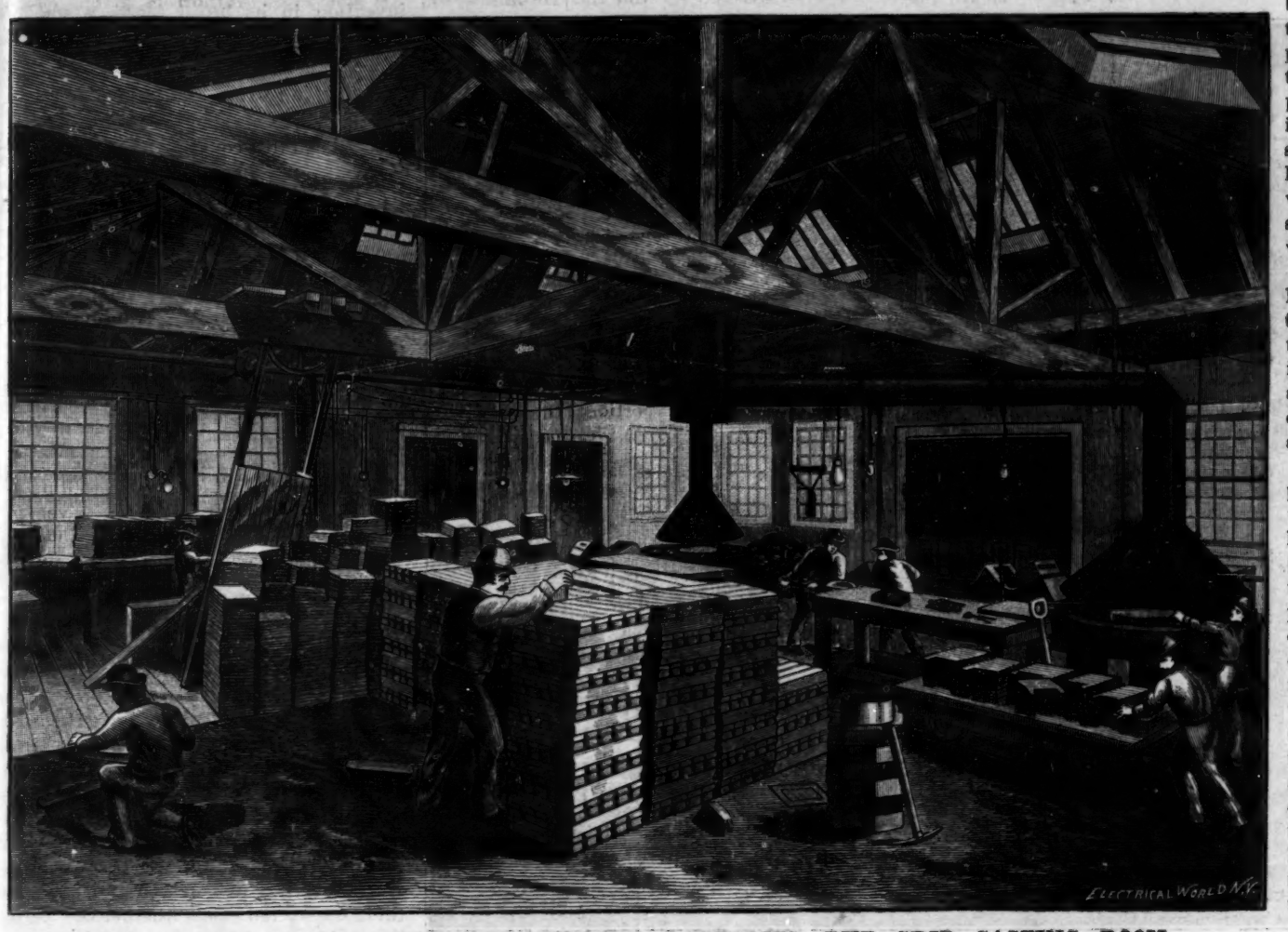


FIG. 1—THE MANUFACTURE OF STORAGE BATTERIES. THE GRID CASTING ROOM.

Although they are in quite extensive use abroad during the last few years, the introduction of storage batteries here has been somewhat slow; but considering the large facilities which have now been created, and the opportunities which have presented themselves during the past year, it is safe to assert that the near future will see them applied in many ways, and their influence will be most marked. During the last few months, there has been established in the city of Newark for the manufacture of storage batteries a series of workshops the size and extent of which is probably known to but comparatively few persons. These works of the Electrical Accumulator Company, of this city, now have a capacity for making over 500 cells per week, and are laid out in a manner which is calculated to render the manufacture of the cells most systematic and regular. During a recent visit we had the pleasure of inspecting there the operations connected with the manufacture of storage batteries from beginning to end, and as our readers will no doubt be interested, we propose to take a walk through the factory with them, and note the points of importance as they come up.

Let us begin with the first process. The skeletons of the cells, the leaden grids, are cast in the foundry illustrated in Fig. 1. Here are two furnaces in which lead pots capable of holding a ton of lead each are placed. The molten metal is ladled out by two men, and poured into a mold having the form of the grid. The plates, as they come from the mold, then have their rough edges trimmed off in a cutting machine, and are straightened out. The plates are next passed into the "pasting room." This department is shown in Fig. 2. The workmen, placing the grids before them, take the paste, which has previously been prepared, and, by means of heavy spatulas, press and work it into the grids. The positive plates are pasted with red lead, the negative with a special form of litharge. After being pasted the plates are passed to the "drying room," where they are thoroughly dried, so as to allow the active material to "set" before being subjected to the forming process.

When thoroughly dried, the cells are ready to be "formed," and for that purpose are transferred to the "forming room" shown in Fig. 3. This room is nearly 150 feet long and 50 feet wide, and has four rows of double cells, extending nearly its whole length, in which the plates are formed. Between each row of cells will be seen a system of pipework and glass siphons. By means of these the acid necessary for the formation of the plates can be supplied to the cells and drawn off again at will. In this room, as well as in all the others, it will be noticed that a system of overhead travelers is provided, through whose intervention the cells and all other heavy material can be transported from one end of the works to the other with the greatest ease.

FIG. 2.—THE MANUFACTURE OF STORAGE BATTERIES. THE PASTING ROOM.

The positive and the negative plates are each formed by themselves. For that purpose a series of positive plates are alternated with a number of "dummy" or plain lead grids; and, in the same way, the negative plates are also alternated with dummy grids. Plates of each class are formed separately by passing the current through them. In the case of the positive plates which have been pasted with red lead, the red lead is converted into a peroxide of lead. This process of formation for the positive plates requires about a week's time. The negative plates which have been pasted with the special form of litharge are, during the process of their formation, reduced to spongy lead. This process for the negative plates takes about two and a half days. When the latter, after being formed, are taken out of the solution, the nascent hydrogen occluded within the pores eagerly combines with the oxygen of the atmosphere and heats the plate quite perceptibly. In order to prevent this heating from reaching a dangerous point, a spray is provided under which the spongy lead or "hydrogen plates" are placed, and whenever the heat becomes too marked, a spray of cold water is thrown over them which brings down their temperature.

For the 330-ampère cells made by the Electrical Accumulator Company, 8 negative and 7 positive plates are used, a negative plate being at either end. After being formed, the negative plates are plugged at about a dozen points with small plugs of rubber, which serve to keep the plates apart and allow the solution to circulate.

The plugging of the plates is accomplished by means of an automatic machine, which replaces the work of a dozen boys heretofore required for that purpose. The plates are then inspected, and if no defect is noticeable, they are bound together and placed upside down, so that the projecting connecting strips attached to the grids bear on a band of lead. The ends of the connecting strips are then fused to the lead band with a blow-pipe. No solder is employed, as the action of the sulphuric acid within the cells in actual use would be likely to attack any alloy and thus ultimately destroy the continuity, or at least seriously impair the conductivity of the circuit. Finally, the band joining the positive plates is painted red, and that joining the negative plates black, so that they can be easily distinguished. The plates are now ready for actual work.

Passing on from the forming room we come into the dynamo room, where the machines for generating current for the forming process are placed. This room is shown in Fig. 4. As will be seen, it contains 10 dynamos, 4 of the Edison type and 6 designed by Mr. W. W. Griscom (of motor fame), president of the Electro-Dynamic Company, of Philadelphia. Eight of these machines are running regularly and continuously, as the works are kept in operation day and night, and two dynamos are kept in reserve. The wires from each dynamo run along the wall and are connected to a switch-board, shown at the end of the room. By means of this board, the machines can be coupled up in any desired manner and connected in the same way with the cells in the forming room. With these

eight machines great latitude of manipulation is permissible, so that all the conditions which may be met with in the work can be readily fulfilled. The switch-board is provided with voltmeters and ammeters which are mounted upon wheels, so that they can be easily shifted from one side to the other.

FIG. 3.—THE MANUFACTURE OF STORAGE BATTERIES. THE FORMING ROOM.

Just off from the dynamo room is the engine room, a glimpse of which can be seen in the illustration, Fig. 4, through the open door. Here is placed a double Watts-Campbell engine capable of developing 200 h. p. and amply sufficient for all the needs of the works. The boiler room, adjoining the engine room, contains three boilers, and the works enjoy the distinction of being possessed of the tallest iron smoke-stack in the city of Newark.

The cells, after being formed and placed in thorough working condition, are then transferred to the packing room, where they are packed in a special manner, so as to prevent all possible injury during transportation. It will have been noticed that, as shown in the engravings, rails are laid throughout the shops, so that heavy weights can be transported readily; and, as stated before, over-head traveling pulleys are similarly placed, so that movement of material within the works is fully provided for. Connection with the outer world, for freighting purposes, etc., is also convenient. The railroad runs right into the works, so that coal can be dumped from the cars straight into the boiler room. Thus the expense of separate handling is obviated.

The factory is lighted throughout by a separate battery of cells which are always kept charged.

Thus far we have only spoken of the works themselves, but in connection therewith the offices and laboratory deserve a word of mention. These occupy a separate three-story building 25 ft. × 60 ft. The ground floor front of this building is used as a general office and the rear as a laboratory. The second floor in the rear is used as a drafting room and the remainder of this floor and the whole of the next is devoted to the uses of the engineering staff. It comprises dining-room, kitchen and sleeping apartments, fitted up in very neat style.

Throughout the works forethought in arrangement and economy in the details of manufacture are noticeable. Every means has been employed and every precaution taken to make the product as uniform a one as possible, and at every stage of the work the product is subjected to rigid inspection, so that any slight fault which may be developed is immediately detected and remedied. As stated before, the works have a capacity of making 500 cells per week, and, with a rapid increase in the application of the storage battery, it is safe to say that while even now this capacity is taxed to the utmost, it will soon be inadequate to meet the demands which will be made by new fields of utilization.

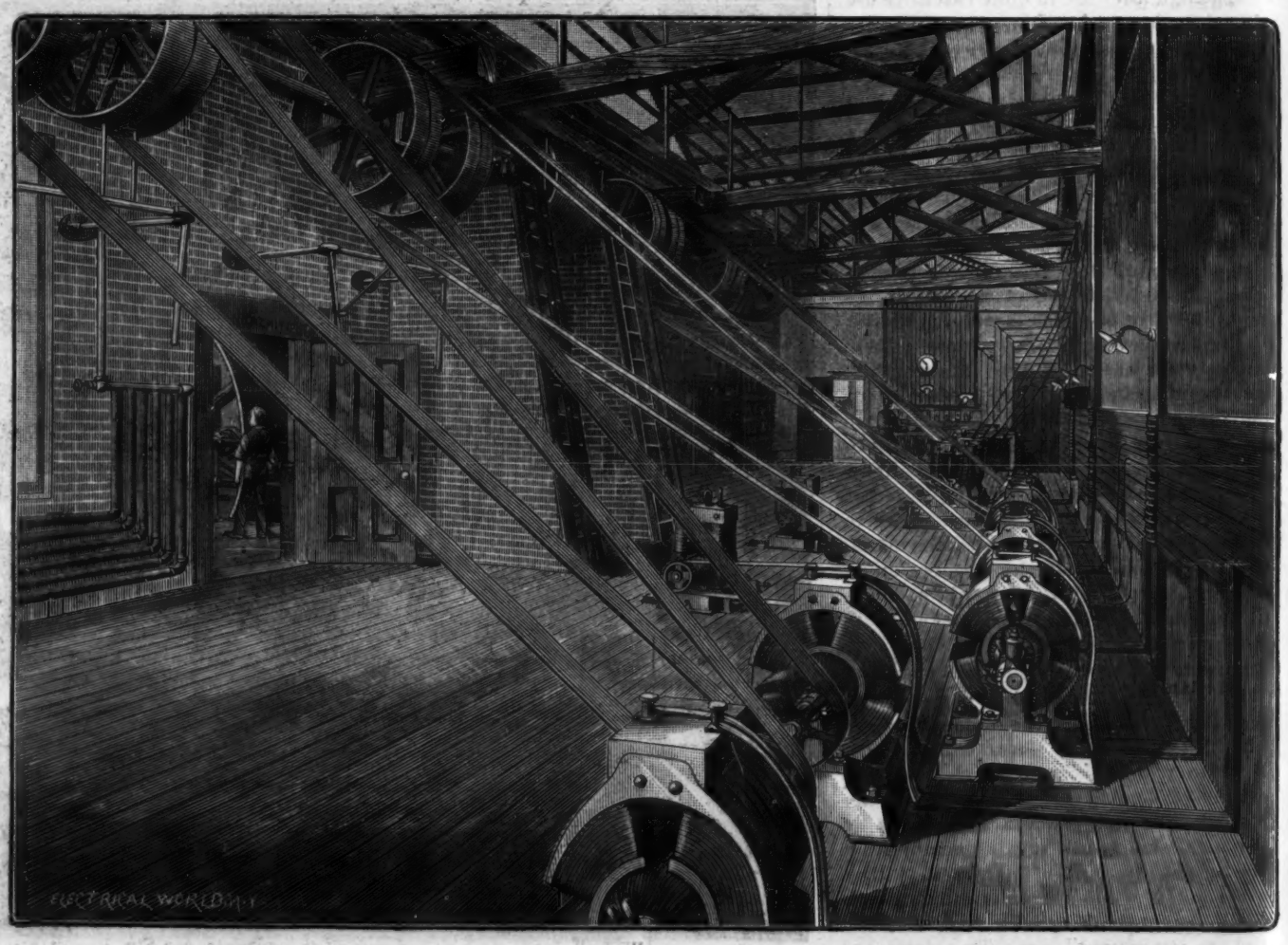


FIG. 4.—THE MANUFACTURE OF STORAGE BATTERIES. THE DYNAMO ROOM.

What is Invention?

To the Editor of The Electrical World:

SIR: I note in your paper for June 4 the definition for "invention," given by Mr. J. M. Hughes. It seems to me that his definition falls far short of its object. It is too limited or circumscribed. A single simple test will prove this. For example, an invention which may be defined as a method or process (which form a large proportion of inventions) could not be defined as "a device arranged, constructed or applied," etc. Thus the fifth claim of the Bell telephone patent is for the method or art, and is not for a device; so was the great claim of the Tighlman saponification patent, which has been involved in litigation for years past, and been repeatedly sustained by the Supreme Court. I could give hundreds of instances where the invention is not a device nor a thing.

An invention comprehends any completed thought which involves the use of the inventive faculties and embodies novelty and utility. The mere abstract idea is not to be considered as invention, but it must be capable of being grasped by one skilled in the art to which it appertains, and carry with it utility to some degree, however slight. It need not necessarily be reduced to paper, model or machine, nor to be carried into execution, as the invention in its broad sense would still exist in the brain of the inventor and could at any time be reduced to practice either by himself or by his direction.

These facts are daily brought to my notice, for, having made many hundreds of inventions of my own, and described thousands of inventions for my clients, I know that large numbers of inventions are not devices, machines or mechanism, but can only be defined by acts or steps in manipulation with something *per se* previously well-known.

I would therefore offer either of the following definitions:

1. An invention is the result of exercise of the inventive faculties when the idea conceived is so completed as to carry novelty and utility.

2. An invention is a perfected idea combining novelty and utility and involving more than mechanical skill in its perfection.

3. An invention is a conception of the mind exhibited in an act, method, process, or thing, embodying novelty and utility.

The words novelty and utility may be objected to, but no invention whether complete in itself or only a part of a complete structure or process, can exist without novelty and utility. Without these requisites, it is not invention. It is also to be borne in mind that invention is to be distinguished from discovery, which requires no exercise of the inventive faculty although it may result while the discoverer was inventing for another object. The thing discovered exists whether the person sees or knows of its existence or not.

R. M. HUNTER, M. E.

Tests of Insulated Wire.

To the Editor of The Electrical World:

SIR: Please allow a word of explanation relative to tests, stated in last week's issue to have been made by H. B. Prindle, Portland, Me., to determine the relative value of various insulations for circuits of high potential.

These tests were arranged by the writer, not as an advertisement for the product of any factory, but as a matter of private information to the Edison Company. The report in public print, therefore, is very bad taste. It is somewhat important to state also that no such record regarding the durability of the "Campbell" wire is in existence in the Edison office.

W. J. JENKS.

NEW YORK CITY.

Economical Electrical Distribution.

BY PROF. J. BURKITT WEBB, STEVENS INSTITUTE OF TECHNOLOGY.

It has recently been the duty of the writer to make some computations with regard to the most economical distribution of an electric current, which may prove of interest to the readers of THE ELECTRICAL WORLD.

PROBLEM: Let it be required to light a certain district having given the number of lamps and their positions, as well as the average "drop," loss of potential, or fall in the electromotive force allowable. Suppose also that the lights are so situated that there is no doubt as to the best location for the mains, sub-mains and branches, nor for the "distributing points" where the mains branch into sub-mains, or the latter into branches.

Were the case such as to admit of diagonal lines the problem might properly include the selection of the best course for the wires, which leads to some interesting problems; but where highways have to be adhered to it is often clear that the wires must follow a certain course or its equivalent.

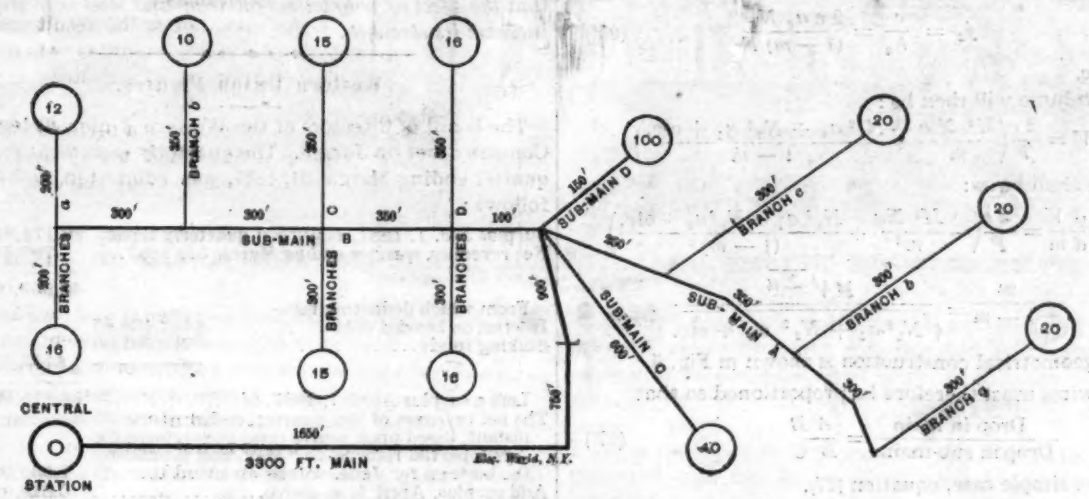


FIG. 1.—ECONOMICAL ELECTRICAL DISTRIBUTION.

Following, therefore, the paths decided upon, for the wires, let there be n_1, n_2, n_3, etc., lights at the respective numbers of feet from the dynamo station, d_1, d_2, d_3, etc. Let the current required for each light be a ampères at v (volts) potential and let the loss in the distribution be limited to an *average* fall of potential, or "drop," of r per cent. of the total potential. Required the sizes of the wires needed.

If the potential required at the lights be v and the drop or fall of potential $= F = r$ per cent. of v_0, the dynamo potential, then

$$v = \frac{100 - r}{100} v_0;$$

or at the dynamo the potential is

$$v_0 = \frac{100}{100 - r} v$$

and the drop $= F = \frac{r}{100} v_0 = \frac{r}{100 - r} v.$ (1)

This drop is for the average or "representative lamp," the distance of which from the station we must now find. Multiplying the number of lamps at each point by their distance, adding these products and dividing by the total number of lamps (a process analogous to finding the centre of gravity of the lamp system) we obtain the distance D of the "representative lamp," or the average distance of the lamps from the dynamo.

Thus putting

$N = n_1 + n_2 + n_3 + \text{etc.} =$ the total number of lamps.

$$D = \frac{n_1 d_1 + n_2 d_2 + n_3 d_3 + \text{etc.}}{N} = \frac{\Sigma (nd)}{\Sigma (n)} \quad (2)$$

The proper size of wire will be such as to allow of the specified drop in D feet, and the drop will be less (greater) for lamps nearer to (further from) the dynamo. This variation of potential at the lamps will be found by multiplying the drop per foot

$$f = \frac{F}{D} = \frac{r v}{D (100 - r)} \quad (3)$$

by the variation of the distance of each lamp from the average distance; thus, for a lamp whose distance is d, there will be an

$$\text{excess of potential} = \Delta v = (D - d) f = \left(1 - \frac{d}{D}\right) \frac{r v}{100 - r} \quad (4)$$

For lamps where d is greater than D this, of course, becomes a deficiency of potential.

To find the sizes of wire needed we first find what would be required for the "representative lamp," D feet distant from the dynamo. The resistance h per foot (single) of such a wire will be

$$h = \frac{f}{2a} = \frac{rv}{2aD(100 - r)} \quad (5)$$

(f is the drop per foot of distance, but, there being both direct and return wires, $\frac{f}{2}$ must be used here), so that, by Dr. Matthiessen's standard of 13.6 ohms for 5,280 feet of $\frac{1}{16}$ inch copper wire, we have for the section j of this wire:

$$j = \frac{\pi \times 13.6}{4 \times 16^2 \times 5280\, h} = \frac{\pi \times 136 \times 2aD}{32^2 \times 52800 \times rv} (100 - r) \quad (6)$$

If now the "main" is to carry the current for N such lamps, its section will be:

$$\text{Section of main} = Nj; \quad (7)$$

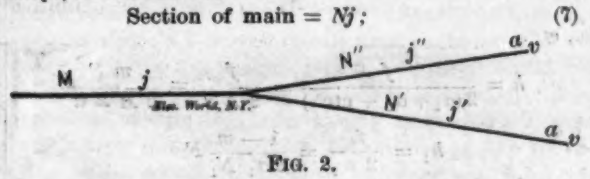


FIG. 2.

that of "sub-mains" to supply N_1, N_2, etc., lamps:

$$\text{Sections of sub-mains} = N_1 j, \text{ etc.}; \quad (8)$$

that of "branches" to supply n_1, n_2, etc., lamps:

$$\text{Sections of "branches"} = n_1 j, \text{ etc.}; \quad (9)$$

the section of any wire being proportional to the number of lamps to be supplied.

Where there is a uniform fall of potential per foot, a main, sub-main or branch is in reality nothing more than a bundle of as many separate lamp wires as happen to run together made into one wire for convenience, and the section of any such larger wire is the sum of the sections of the single lamp wires, which it may be supposed to replace.

If all the lamps do not require the same number of ampères, then the formulæ produced are still true if we let n_1, n_2, etc., stand for the number of ampères required at each point, and N for the total number of ampères, and our representative lamp will then be a lamp requiring one ampère. a will also stand for one ampère, and will therefore, disappear from the equations.

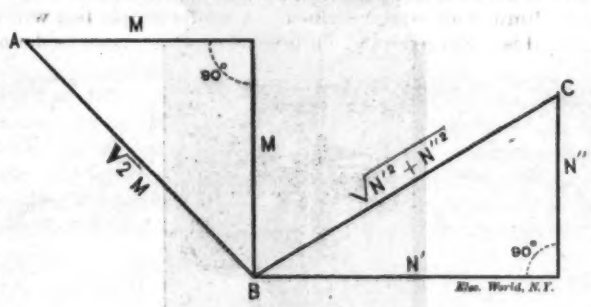


FIG. 3.

As a practical instance of such a calculation, we give here the actual figures for lighting a portion of the suburbs of a town of almost 14,000 inhabitants, see Fig. 1.

The numbers inclosed in circles indicate the number of lights supplied at each point.

The potential v required at the ends of the branches is 1,000 volts with $\frac{1}{100}$ ampère per lamp, and the average drop is not to exceed two per cent.

By (1) we have

$$F = \frac{2}{100 - 2} \times 1{,}000 = 20.4 \text{ volts for the entire drop, or loss of potential.}$$

By (2)

$$D = \frac{1164850}{300} = 3{,}883 \text{ feet, as the distance of the representative lamp.} \quad (3) \text{ gives}$$

$$f = \frac{20.4}{3883} = 0.0053 \text{ volts drop per foot. Applying (4) to the farthest and nearest lights to the central station, we have}$$

$$\Delta v = (3883 - 4550) \times 0.0053 = -3.5 \text{ volts} \left(\begin{matrix}\text{deficiency below} \\ \text{1,000 volts}\end{matrix}\right)$$

$$\Delta v = (3883 - 3450) \times 0.0053 = 2.3 \text{ volts} \left(\begin{matrix}\text{excess above} \\ \text{1,000 volts.}\end{matrix}\right)$$

The resistance per foot of wire for the representative lamp is, by (5),

$$h = \frac{f}{2a} = \frac{0.0053}{0.06 \times 2} = 0.044 \text{ ohm.}$$

The section of the representative wire (single) will therefore be (6)

$$j = \frac{\pi}{4} \frac{13.6}{\times 16^2 \times 5280 \times 0.044} = 0.00018 \text{ sq. inches.}$$

For the main, sub-mains and branches, we shall therefore have, according to (7), (8) and (9), the following:

Wires.	No. of lights	Single section.	Resistance per 1,000 ft.	Suitable gauge No.
Main.....	300	0.054 sq. in.	.15 ohms.	2
Sub-main A.....	60	0.011 "	.78 "	8
" B.....	100	0.018 "	.44 "	6
" C.....	40	0.007 "	1.1 "	10
" D.....	100	0.018 "	.44 "	6
Smallest branch..	10	0.002 "	4.4 "	16
Largest branch..	20	0.004 "	2.2 "	13

Should it be desirable to reduce the variation of potential Δv, we may do so by using a proportionally greater "drop" for the main. Thus, to make Δv one half, one third, or, in general, m times what it is according to equation (4):—

Put $\Delta' v = m\, \Delta v$, and $f' = m f$; then by (4)

$$\Delta' v = (D - d) f';$$

from which we find for the sub-mains and branches the

$$\text{diminished drop per foot } f' = m f = \frac{m}{D} \times \frac{r v}{100 - r}; \quad (10)$$

$$\text{and } \Delta' v = (D - d)\, m f = \left(1 - \frac{d}{D}\right) \frac{m r v}{(100 - r)}. \quad (11)$$

Putting M for the length of the main, we have for the average diminished drop beyond the main

$$F' = (D - M)\, m f. \quad (12)$$

$$= \left(m - \frac{m M}{D}\right) \frac{r v}{100 - r};$$

leaving for the main an

$$\text{increased drop} = F'' = F - \left(m - \frac{m M}{D}\right) \frac{r v}{100 - r}$$

$$= \frac{r v}{100 - r} - \left(m - \frac{m M}{D}\right) \frac{r v}{100 - r}$$

$$= \left[1 - \left(m - \frac{m M}{D}\right)\right] \frac{r v}{100 - r}, \quad (13)$$

which will give for the main an

$$\text{increased drop per foot} \left\} = \frac{F''}{M} = \frac{D - m D + m M}{M D} \times \frac{r v}{100 - r} \right. \quad (14)$$

This will require for the representative lamp 2 M feet of wire of

$$\text{resistance} = \frac{D - m D + m M}{2 a M D} \times \frac{r v}{100 - r} \quad (15)$$

and 2 $(D - M)$ feet of wire of

$$\text{resistance} = \frac{m}{2 a D} \times \frac{r v}{100 - r}; \quad (16)$$

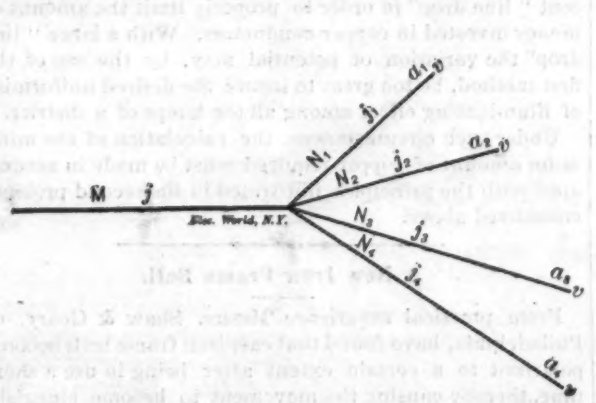
We shall also have:

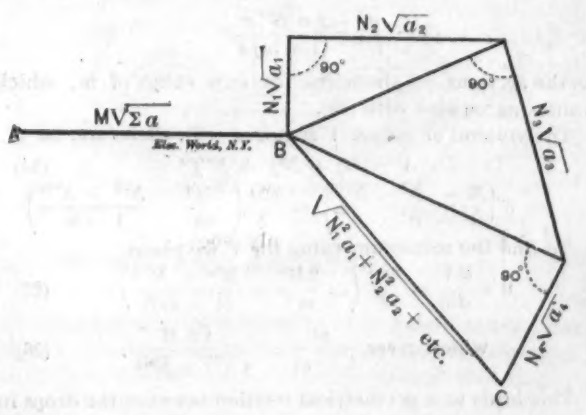
$$\text{Section of main} = N \frac{M}{D - M D + m M} j \quad (17)$$

$$\text{Sections of sub-mains} = \frac{N_1}{m} j, \text{ etc.}, \quad (18)$$

$$\text{Sections of branches} = \frac{n_1}{m} j, \text{ etc.}, \quad (19)$$

Suppose that in the example above given we wish to diminish Δv to one-third of its value as above calculated, making it therefore — 1.2 volts and 0.8 volts.





FIGS. 4 AND 5.

According to the previous discussion we have:

Wires.	No. of lights.	Single section.	Resistance per 1,000 ft.	Suitable gauge No.
Main.....	300	0.048	.17	2
Sub-main A.....	60	0.033	.24	4
" B.....	100	0.054	.15	2
" C.....	40	0.021	.37	6
" D.....	100	0.054	.15	2
Smallest branch..	10	0.006	1.47	12
Largest branch...	20	0.012	.73	8

This evidently increases considerably the weight of copper required, but as the sizes are not large there is no objection on the score of cost.

To allow for extensions the main may be No. 1, which

will also reduce the total drop, and, to secure uniformity, the sub mains may be run of No. 3 and the branches of No. 8 wire.

It will be noticed that although No. 3 is less than the calculated size for sub-mains B and D, yet the lamps supplied by D are less than the average distance from the station, so that with No. 2 wire they would have too high a potential; also B branches after 100 feet, so that its total resistance made of No. 3 will be less than if of No. 2 for 100 feet, and of properly diminishing section the rest of the way, and therefore the variation of potential at the extreme lights may still not exceed $m \Delta v$.

By admitting such a slight variation in potential as we have just discussed, the advantages of a uniform system of wiring may often be secured; if, however, it be required to so wire a district that the potential at the various points of delivery of the current shall be exactly the same, it may be done by suitably varying the sizes of the wires used for sub-mains and branches. We will discuss a case of such wiring.

PROBLEM: To deliver a_1, a_2, a_3, etc., ampères of potential v at the respective distances N_1, N, N_2, etc., by means of a main M feet long and several sub-mains, all diverging from the end of the main. It is of no use here to make the supposition that each lamp or set of lamps is wired direct, and that these direct wires bundled together form the mains, as in the preceding discussion, because, owing to the difference in the distances, the drop per foot would not be the same in all the wires; and therefore the uniting of several wires in one would change the distribution of the current and of the potential. We shall have recourse to the calculus to find the minimum weight of wire.

To make the nature of the problem clearer, we present first a

SIMPLE CASE: Let a main M divide into two sub-mains N' and N'' long, both supplying a ampères of potential v, as in Fig. 2.

Evidently the same fall of potential must occur along N' and N''; therefore their sections must be proportional to their lengths or

$$\frac{j'}{N'} = \frac{j''}{N''} \qquad (20)$$

Putting again F for the whole fall of potential and letting $m F$ = the fall on the main, we shall have for the drops per foot on main and sub-mains respectively:

$$f = \frac{m}{M} F$$

$$f' = \frac{1-m}{N'} F \qquad (21)$$

$$f'' = \frac{1-m}{N''} F.$$

And the resistances per foot:

$$h = \frac{f}{2 \times 2a} = \frac{m}{4\ a\ M} F$$

$$h' = \frac{f'}{2\ a} = \frac{1-m}{2\ a\ N'} F \qquad (22)$$

$$h'' = \frac{f''}{2a} = \frac{1-m}{2\ a\ N''} F.$$

Putting for

$$\frac{\pi \times 13.6}{4 \times 5280 \times 16^2} \text{ the symbol } c$$

we have

$$j = \frac{c}{h} = \frac{4\ a\ M\ c}{m\ F}$$

$$j' = \frac{c}{h'} = \frac{2\ a\ N'\ c}{(1-m)\ F} \qquad (23)$$

$$j'' = \frac{c}{h''} = \frac{2\ a\ N''\ c}{(1-m)\ F}$$

as the sections of the wires for any value of m, which values agree also with (20).

The volume of copper V required will, therefore, be

$$V = Mj + N'j' + N''j'' \qquad (24)$$

$$= c\left(\frac{M}{h} + \frac{N'}{h'} + \frac{N''}{h''}\right) = \frac{2ca}{F}\left(\frac{2M^2}{m} + \frac{N'^2 + N''^2}{1-m}\right)$$

To find the minimum value for V we place

$$0 = \frac{dV}{dm} = \frac{2ca}{F}\left(-\frac{2M^2}{m^2} + \frac{N'^2 + N''^2}{(1-m)^2}\right); \qquad (25)$$

$$\text{which gives } \frac{m}{1-m} = \frac{\sqrt{2}\,M}{\sqrt{N'^2 + N''^2}}. \qquad (26)$$

This leads to a geometrical relation between the drops in the main, and sub-mains, as shown in Fig. 3.

By proportioning the wires so that

$$\frac{\text{Drop in main}}{\text{Drop in sub-main}} = \frac{AB}{BC} \qquad (27)$$

the distribution will be accomplished with the least weight of wire.

We will now discuss a more

GENERAL CASE.—Let the main M divide into any number of branches N_1, N_2, N_3, etc., which are to carry, respectively, a_1, a_2, a_3, etc., ampères, as in Fig. 4, and furnish it at a potential v with a total loss of potential of F.

Following a similar course of analysis we get the following equations:

$$\frac{j_1}{a_1 N_1} = \frac{j_2}{a_2 N_2} = \frac{j_3}{a_3 N_3} = \text{etc.,} \qquad (20')$$

$$f = \frac{m}{M} F \qquad (21')$$

$$f_1 = \frac{1-m}{N_1} F$$

$$f_2 = \frac{1-m}{N_2} = F$$

etc., etc.

$$h = \frac{f}{2(a_1 + a_2 + \text{etc.,})} = \frac{f}{2\Sigma a} = \frac{m F}{2 M \Sigma a}$$

$$h_1 = \frac{f_1}{2\ a_1} = \frac{1-m}{2 a_1 N_1} F$$

$$h_2 = \frac{f_2}{2 a_2} = \frac{1-m}{2 a_2 N_2} F \qquad (22')$$

etc., etc.

$$j = \frac{c}{h} = \frac{2\ c\ M \Sigma a}{m F}$$

$$j_1 = \frac{c}{h_1} = \frac{2\ c\ a_1 N_1}{(1-m) F}$$

$$j_2 = \frac{c}{h_2} = \frac{2\ c\ a_2 N_2}{(1-m) F} \qquad (23')$$

etc., etc.

The volume will then be:

$$V = \frac{2c}{F}\left(\frac{M^2 \Sigma a}{m} + \frac{N_1^2 a_1 + N_2^2 a_1 + \text{etc.}}{1-m}\right)$$

and we shall have:

$$0 = \frac{dV}{dm} = \frac{2c}{F}\left(-\frac{M^2 \Sigma a}{m^2} + \frac{N_1^2 a_1 + N_2^2 a_2 + \text{etc.}}{(1-m)^2}\right)$$

$$\frac{m}{1-m} = \frac{M\sqrt{\Sigma a}}{\sqrt{N_1^2 a_1 + N_2^2\ a_2 + \text{etc.}}}$$

The geometrical construction is shown in Fig. 5.

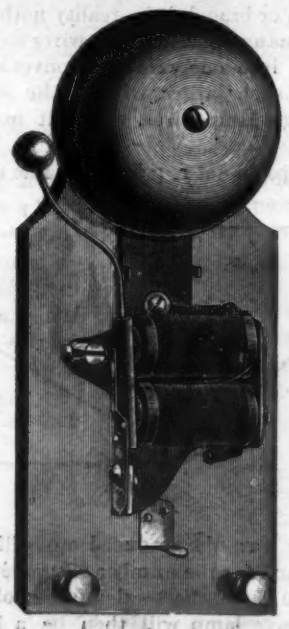
The wires must therefore be proportioned so that

$$\frac{\text{Drop in main}}{\text{Drop in sub-mains}} = \frac{A\ B}{B\ C} \qquad (27')$$

as in the simple case, equation (27).

The application of a low potential system of say 200 volts to the distribution of electricity over an area requiring such lengths of mains as occur in the example cited above, would make it necessary to allow at least 10 per cent "line drop" in order to properly limit the amount of money invested in copper conductors. With a large "line drop" the variation of potential may, by the use of the first method, be too great to insure the desired uniformity of illuminating effect among all the lamps of a district.

Under such circumstances, the calculation of the minimum amount of copper required must be made in accordance with the principles illustrated in the second problem considered above.



A NEW IRON FRAME BELL.

A New Iron Frame Bell.

From practical experience Messrs. Shaw & Geary, of Philadelphia, have found that cast-iron frame bells become polarized to a certain extent after being in use a short time, thereby causing the movement to become sluggish. The bells become weak from no apparent cause, and additional battery does not remedy the defect.

In their new style bell only the best Norway iron is used, which being of a soft nature does not readily retain its magnetism.

The armature spring is of German silver, and so constructed that it can be easily adjusted for light or heavy currents. The contact points are made of pure platinum, securely riveted into position, and the magnets are carefully wound to 3¼ ohms resistance with the best insulated wire.

The gong and binding-posts are handsomely nickel plated, the latter being made on the order of the English binding post, with long screw, allowing two or more wires being wound under the head without danger of its dropping off.

Effects of Magnetism on Strength of Iron and Steel.

BY N. MARSHALL, DAYTON, O.

Noticing in THE ELECTRICAL WORLD of June 4, the editorial remarks in regard to "the effect of magnetism on the strength of iron and steel," calls to mind some experiments, in that direction, made two years ago at the Worcester Technical Institute, the results of which, I think, have never been published.

These experiments, with which the greatest care was taken to obtain trustworthy results, were conducted mainly as follows: Several long uniform rods of iron and steel were cut into short lengths, and each alternate length was magnetized to saturation. While thus magnetized, they were broken in a testing machine, as were also the unmagnetized pieces. The object of treating alternate pieces of the rods was to avoid any error that might arise from inequalities in different parts. Although I do not now recall the exact figures of the experiments, the magnetized pieces invariably showed a slightly higher tensile strength than the unmagnetized pieces, thus proving conclusively that *the effect of magnetism on iron and steel is to slightly increase its strength.*

Western Union Figures.

The board of directors of the Western Union Telegraph Company met on June 8. The quarterly statement for the quarter ending March 31, 1887, was submitted, and is as follows:

Surplus Jan. 1, 1887, as per last quarterly report.		$6,171,810.28
Net revenues, quarter ending March 31, 1887....		787,582.93
		$6,959,393.21
From which deducting for—		
Interest on bonded debt	$123,469.85	
Sinking funds	19,991.00	
		$143,460.85
Left a surplus April 1, 1887, of.....		$6,815,932.36
The net revenues of the quarter ending June 30 instant, based upon nearly completed returns for April, partial returns for May, and estimating the business for June, will be about....		1,050,000.00
Add surplus, April 1, as above.....		6,815,932.36
		$7,865,932.36
From which appropriating for—		
Interest on bonds	$123,500.00	
Sinking funds.....	20,000.00	
		143,500.00
Leaves a balance of		$7,722,432.36
It requires for a dividend of 1 per cent. on the capital stock...		812,000.00
Deducting which leaves a surplus after paying dividend of.....		$6,910,432.36

In view of the favorable statement the executive committee recommended that a dividend of 1 per cent. on the capital stock of the company be declared, the same to be payable on and after the 15th day of July next to the stockholders of record June 20, and that the stock books of the company be closed at 3 o'clock P. M. on June 20 and be reopened July 2. The recommendation was unanimously adopted and the dividend was declared.

Horizontal Intensity of the Earth's Magnetism.

To the Editor of The Electrical World:

SIR: I would like to be informed how large the horizontal intensity of the earth's magnetism is in the city of New York. JOS. BROICH.

BROOKLYN, N. Y.

ANSWER.—Through the kindness of Prof. Ogden N. Rood, of Columbia College, we have been informed that in his laboratory the value of the horizontal component of the earth's magnetism is .1872. This means that the intensity of the earth's field in a horizontal direction is .1872 lines of force per square centimetre, or in other words that through every vertical square centimetre .1872 lines of force pass. As each line of force exerts a force of one dyne on a unit magnetic pole, it follows that .1872 is the force in dynes which this component exerts on a unit magnetic pole. This figure, however, varies greatly even in different parts of the same building. For instance, quite near the building in which this was measured it was .229 and in the University of Pennsylvania in Philadelphia it was .19 and .25 in two places not 10 feet apart, while 100 feet from these it was .17. This shows that if this figure is to be used for accurate work, it should be determined precisely the same place in which it is to be used. Iron in the neighborhood, particularly when north or south of the needle, generally increases this horizontal component, except when it completely surrounds the needle, in which case it acts as a shield and diminishes magnetic action on the needle.—EDS. E. W.

The Direction of Current in a Battery.

To the Editor of The Electrical World:

SIR: Please inform me, through your journal, in what direction the current of an open circuit battery flows in the cell itself. Is it from zinc to carbon or the reverse? I see some authorities (?) differ. X.

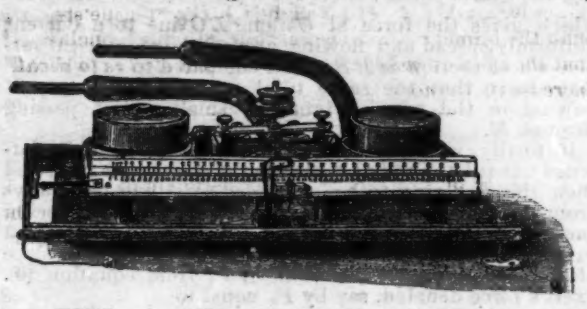
ANSWER.—As the zinc terminal of a battery is the negative pole *into* which the current flows, it necessarily follows that the current must flow from the zinc plate in the cell through the liquid *to* the carbon, which is the reverse direction to that in the external circuit in which it flows from the carbon, or positive pole, to the zinc, or negative pole. It must always flow in the reverse direction in order to make a complete circuit. The zinc *pole* is negative to the external circuit, but is the *positive plate* in the liquid. The current in a cell itself (or in a voltameter) always flows in the direction in which the metal, which is dissolved, appears to flow.

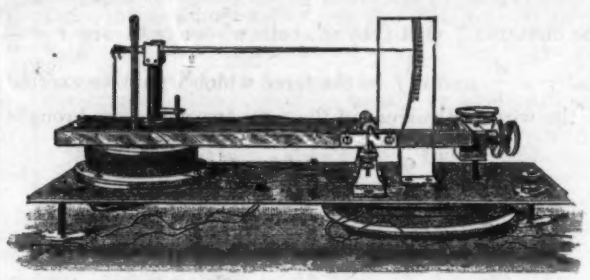
As we do not know the real direction of the current or

whether it flows at all, as, for instance, if it should be found to be like a wave motion, it is not strictly correct to say it flows from the positive to negative poles, but for the sake of convenience it is universally supposed to flow in that direction.—EDS. E. W.

Sir William Thomson's New Electric Measuring Instruments.

The standard electric balances devised by Sir William Thomson depend on the neutral forces exerted between fixed and movable portions of an electric circuit. In the balance instruments each movable ring is actuated by two fixed rings, and there are two such groups of three rings—two movable rings attached to the two ends of a horizontal arm pulled, one of them up and the other down, by a pair of fixed rings in its neighborhood. The current is in opposite directions through the two movable rings to practically annul disturbance due to horizontal components of terrestrial or local magnetic forces. In the direct reading voltmeter there is only one fixed ring acting on a single movable ring, which is attached to one end of the balance arm and counterpoised by a weight at the other end.





FIGS. 1 AND 2.—NEW STANDARD BALANCE AND ENGINE ROOM VOLTMETER.

In all the instruments the balance arm is supported by two trunnions, each hung by an elastic ligament of fine wire, through which the current passes into and out of the circuit of the movable rings or ring, passing in opposite directions through the two fixed rings, so that the movable ring is attracted by one of the fixed rings and repelled by the other.

In the balances to measure direct currents of from 5 ampères to 1,000 ampères the outer diameter of each pair of fixed rings is somewhat smaller than the inner diameter of the movable ring, and the proportions are so arranged that the force experienced by the movable ring is very nearly constant through half a centimetre on each side of its middle position.

In instruments designed to measure alternate currents of all strengths, and direct currents of from 5 milliampères to 10 ampères the fixed rings are larger than in the instruments to measure the larger direct currents. Their outer diameters are greater and their inner diameters less than that of the movable ring which moves between them, above one and below the other. The position of the movable ring equidistant from the two fixed ones is a position of minimum force.

When these instruments are intended to measure alternating currents of from 5 ampères to 1,000 ampères, the main current through each coil is carried by a wire rope having each component wire insulated to prevent the inductive action from altering the distribution of the current across the transverse section of the conductor.

The balancing is performed by aid of a weight which slides on an approximately horizontal graduated arm attached to the balance; and there is a trough fixed on the right hand end of the balance, into which the proper counterpoise weight is placed, according to the particular one of the sliding weights in use at any time.

To measure a current, the left hand weight shown in Fig. 1 is slipped along the scale until the pointer comes to zero—in the same manner as when employing a "rider" on a chemical balance.

The strength of the current is then read off approximately on the fixed white scale (called the inspectional scale) with aid of the finely divided scale for more minute accuracy, according to the explanations given below. Each number on the inspectional scale is twice the square root of the corresponding number on the scale of equal divisions.

The slipping of the weight into its proper position is performed by means of a self-releasing pendant hanging from a hook carried by a sliding platform pulled in the two directions by two silk threads passing through holes to the outside of the inclosure.

Three pairs of weights (sliding and counterpoise) in the ratios of 1 : 4 : 16 or 1 : 4 : 25 are supplied with each instrument, adjusted so that each pair gives a round number of ampères, or half ampères, or quarter ampères, or of decimal sub-divisions or multiples of these magnitudes of current, on the inspectional scale.

The useful range of each instrument is about from 1 to 25 of the smallest current for which its sensibility suffices. Various types of this instrument are made, whose capacity varies from 2 to 50 centi-ampères to 20 to 500 ampères. In each type the pairs of weights have a different value.

The centi-ampère balance is provided with a thermometer to test the temperature of its ampère rings, and with platinoid resistances up to 2,000 ohms, which serve to measure potentials of from 10 volts to 200 volts.

The direct reading vertical-scale voltmeter, or "engine room voltmeter," shows, by inspection, whether the E. M. F. is exactly the proper amount, or, if not exactly so, by what fraction of a per cent., or by what percentage within 10 per cent. above or below, it differs from the proper amount.

The instrument, shown in Fig. 2, consists of a fixed platinoid resistance, in circuit with a fixed and a movable ampère ring; a V-trough rigidly fixed to the movable ring, and carrying the weight proper to the potential to be measured and the temperature of the instrument; a thermometer to show the temperature of the ampère rings; and a lever for multiplying the motion of the movable ring, and showing the potential to be measured on a vertical graduated scale.

The fixed and movable ampère rings are each composed of many turns of fine insulated copper wire, with a total resistance of about 100 ohms. The amount of the added platinoid resistance depends on the potential to be measured in the ordinary use of the instrument. Thus, for example, for potentials of from 10 per cent. below to 10 per cent. above 100 volts, the platinoid resistance is 700 ohms; for potentials of from 10 per cent. below to 10 per cent. above 200 volts, the platinoid resistance is 1,500 ohms.

Temperature error is practically annulled in the use of the instrument, by simply reading the thermometer and seeing that the weight in the trough is the one corresponding to the temperature. Five weights, corresponding to temperatures centigrade of 15, 20, 25, 30, and 35 degrees, are supplied with the instrument in receptacles marked with the temperature, so that no mistake can be made in seeing that it is the right weight that is in use on the instrument at any time.

As the mass of the moving part of the balance voltmeter and engine room voltmeter is too great to be convenient for sea use, a small oblate of soft iron supported on a stretched platinoid wire in the centre of a solenoid of fine copper wire, connected in series with platinoid resistances, variable according to the potential to be measured serves for a marine voltmeter. A pointer carried by the oblate shows, by inspection, direct reading of currents of from 90 to 120 milliampères. When, as is most commonly the case, the mean potential to be measured is 100 volts, the platinoid resistance is adjusted to make up, along with the fine copper wire solenoid (of which the resistance is about 60 ohms) a total resistance of 1,000 ohms. Thus, the direct reading of potential on scale is in volts.

This marine instrument is founded on the principle that an oblate spheroid of soft iron, movable round a diameter, tends to turn its equatorial plane parallel to the lines of force in a uniform magnetic field. In the zero position the equatorial plane of the oblate is inclined about 45 degrees to the lines of force of the solenoid, and torsion by the upper and lower parts of the bearing platinoid wire tends to turn it into a position perpendicular to the lines of force. This tendency is balanced by a stop against the needle when no current, or any current not exceeding 90 milliampères, passes through the solenoid. When a current exceeding 90 milliampères passes, the torsion couple is balanced by the couple due to the electro-magnetic force.

The adjustable resistance or mho-ohm drum is a combination of platinoid conductors fulfilling the double object of an ordinary box of resistance coils and a mho-box by which a set of conductors can be connected in parallel, so that their "conductances" can be added together instead of their resistances as with ordinary resistance coils.

The coils are wound anti-inductively upon copper drums which serve not only for a support but also to conduct away heat produced by the passage of a current. The whole is also surrounded by a copper sheath which admits the use of a water bath about the coils when an extremely constant temperature is required.

All the resistances on the drum are connected in series by permanent solderings. The varying connections for the use of the instrument are made by circular copper cams, mounted on vertical copper shafts, connected by solderings and flexible strands with the soldered joints between the coils in series on the drum. Each shaft is mounted so as to work in two positions, an upper and a lower.

For making the mho connections, all the shafts are placed in the upper position, and the connections are made by turning the cams so as to press on the outer or inner of two concentric copper rings between which the shafts and cams are mounted.

For the ohm connections, the shafts are let down to their lower position, and the connections are made by turning the cams so as to short-circuit whichever of the coils are not to be included in the sum of the resistances in series. The working of this part of the plan is precisely the same as in the ordinary resistance box, except that the short-circuitings are made with easier manipulation by cams with single contacts, instead of by removable plugs with contacts on each side of each plug. This halving of the number of the non-soldered contacts is a great advantage.

In order that the single set of resistances may be available both for the connection in series (for ohms) and for the connection in parallels (for mhos) their proportions must be according to powers of 2 as in ordinary weighing by subdivision of the pound into halves, quarters, eighths, sixteenths (or ounces) and half and quarter ounces. Thus when the smallest single resistance on the drum is 1 ohm the other resistances are 2, 4, 8, 16, 32, 64, 128, 256, 512, 1,024, 2,048 and 4,096 ohms, this last being the highest single resistance on the drum as ordinarily made.

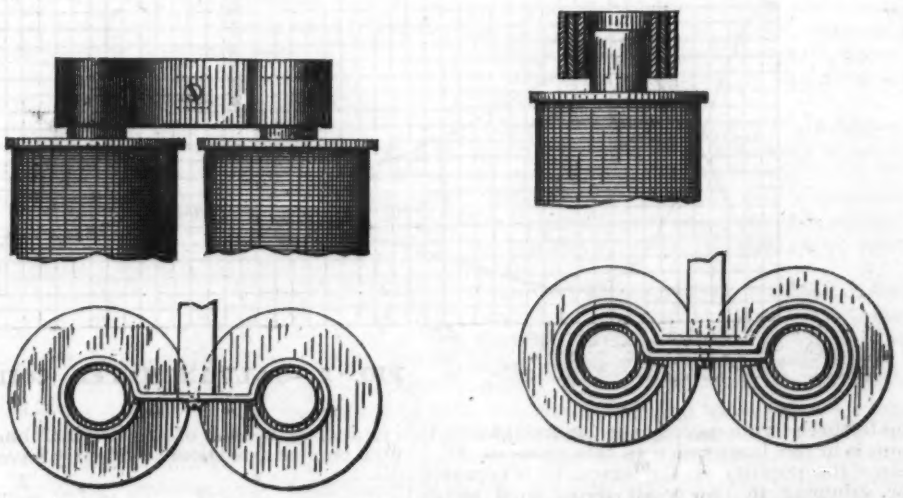
The dual system, besides its availability for the two modes of connection, has this advantage, that with it a smaller number of coils suffice than in any of the decimal systems of resistance coils ordinarily in use.

A Novel Form of Armature for Electro-Magnets.

It is frequently desirable to have a large movement for the armature of an electro-magnet and yet have the magnet exert its full attractive force even when the armature is at a position farthest removed from the magnet. In order to accomplish this object, Mr. Ch. A. Gaiser, of Edwardsville, Ill., has designed a form of armature which exhibits several novel points.

The idea embodied in the new type is to secure one or more thin sheets of iron edgewise to the armature-levers and to have the ends of the sheets surround without contact the magnet cores.

Our illustrations, Figs. 1 and 2, show two views of one form of armature which is made of a single rectangular piece of sheet metal, bent at the ends into loops to fit loosely and without contact over the ends of the magnet cores.



FIGS. 1, 2, 3 AND 4.—NEW FORMS OF MAGNET ARMATURE.

According to the width of the armature sheets, any desired length of movement may be had. By reason of the area of surface exposed to the attraction of the magnet cores, the attractive power in the armatures is largely increased, and by reason of the thinness of the metal of the armature coils the latter are quickly magnetized or demagnetized. The armature sheets or plates being of uniform thickness, the metal in the coils is distributed equally around the magnet cores, resulting in an equal attraction toward all parts of the armature coils.

If an armature of greater power is desired than can be had by the single metal sheet shown in Figs. 1 and 2, the sheet may be doubled, tripled, or increased in number indefinitely. Such a form is shown in Figs. 3 and 4 and embodies the same general principles as shown in the former. The inventor has also designed other forms, embodying the same principle.

The Correction-Factor of a Galvanometer-Coil when the Needle is Displaced Along the Axis.*

BY J. J. SKINNER, PH. D.

(An Elementary Demonstration.)

The text-books of Lamont, Wiedemann and others lay down methods of finding by integration the effect of an electric current in a coil of rectangular section, on a magnet-pole, at any point in the axis of the coil. These methods lead to complicated results. In Maxwell's Treatise, Art. 752, he states that the magnetic force at the centre of the coil, due to a unit current, is the quantity denoted by G_1 in his Art. 700. This statement would, however, seem to be too limited, since the quantity G_1 is a function of the distance from the mean plane of the coil to a point on the axis where the magnetic force is supposed to act. Maxwell finds the value of G_1 as one of the results of a method of approximation by the use of harmonics and the calculus. Mr. H. V. Hayes, in a paper communicated to the Am. Acad of Arts and Sciences, Nov. 11, 1885, and Dr. R. W. Willson, in Annalen der Physik und Chemie, Neue Folge, Band XXVI., 1885, have also treated the subject by the calculus; and the latter also gave some curves showing to the eye the changes due to the coil-section, the galvanometer needle being displaced along the axis of the coil.

The object of the present paper is to give an elementary algebraic deduction of the factor of correction for the current in a coil, as determined by a short magnetic needle at any point on the axis of the coil, the section of the coil being rectangular, and not too large in comparison with the radius.

If a thin wire be coiled into a single circle of radius r, and carry an electric current C, and if a unit magnetic pole be on the perpendicular drawn to the centre of the circle, the distance of the pole from that centre being e, we have the well-known formula for the force exerted on the pole in the direction of the given perpendicular:

$$F = \frac{2\pi r^2 C}{(r^2+e^2)^{\frac{3}{2}}} \qquad (1)$$

In the figure let $L\,O$ be the given perpendicular, the circle of the wire being perpendicular to the plane of the paper, its centre being L, and the wire piercing the plane of the paper at M. The radius is then $L\,M = r$; and if the magnet pole be at O, we have $L\,O = e$.

Now if we suppose the single circular wire, or coil, as it may be termed, to be replaced by two coils in the same plane, and having the same centre L, one of these having a radius $L\,P = r - d$, and the other a radius $L\,Q = r + d$, and suppose each of these new coils to carry a current equal to $\frac{C}{2}$, and denote the respective forces exerted at O along $L\,O$ in this new case by F' and F'', we get by using formula (1) for each, and adding,

$$F' + F'' = \pi C\left\{\frac{(r-d)^2}{[(r-d)^2+e^2]^{\frac{3}{2}}} + \frac{(r+d)^2}{[(r+d)^2+e^2]^{\frac{3}{2}}}\right\}$$

By expanding $(r-d)^2$ and $(r+d)^2$ in the denominators, re-arranging and factoring we may write this without approximation in the form

$$F' + F'' = \frac{\pi C}{(r^2+e^2)^{\frac{3}{2}}}$$
$$\left\{\frac{(r-d)^2}{\left(1+\frac{d^2-2rd}{r^2+e^2}\right)^{\frac{3}{2}}} + \frac{(r+d)^2}{\left(1+\frac{d^2+2rd}{r^2+e^2}\right)^{\frac{3}{2}}}\right\}$$

Assuming that d is small compared with r, the expression $d^2 \pm 2rd$ will be small compared with $r^2 + e^2$. If we then develop to three terms each by the binomial formula all the binomials in the large brace in this value of $F' + F''$, then reduce the quantity in the brace to a common denominator, dropping in the result terms such as d^3, where they are added to r^2, or as d^4 when added to $4r^2d^2$, and the like, and take out a factor $2r^2$, we get—

$$F' + F'' = \frac{2\pi r^2 C}{(r^2+e^2)^{\frac{3}{2}}}$$
$$\left\{\frac{1 + \frac{d^2}{r^2} - \frac{9d^2}{(r^2+e^2)} + \frac{3r^2d^2}{2(r^2+e^2)^2}}{1 + \frac{3d^2}{r^2+e^2} - \frac{6r^2d^2}{(r^2+e^2)^2}}\right\} \qquad (2)$$

Since the terms after the unit in the denominator of the large brace are now small fractions, we may transfer this denominator to the numerator by using the familiar principle of approximations, that if x is a small fraction we may substitute $1 - x$ for $\frac{1}{1+x}$. Making that change in equation (2), multiplying out, dropping the negligible terms, simplifying and substituting the value of F from equation (1) we get

$$F' + F'' = F\left\{1 + d^2\left(\frac{1}{r^2} - \frac{15e^2}{2(r^2+e^2)^2}\right)\right\} \qquad (3)$$

which for convenience may be written:

$$F' + F'' = F(1 + A\,d^2) \qquad (4)$$

A being independent of d.

Notice, that in the two coils that I have supposed to replace the original one, the total length of wire is just twice that of the original coil; and as the current in each of the new coils is half that in the original, the value of F in equations (3) and (4) is the force that would be exerted if the wire of the two new coils, still carrying the current $\frac{C}{2}$, were formed into two complete insulated circles coinciding in the position of the original one.

Now, instead of supposing the original coil to be replaced by two, let there be $2n$ coils, of different radii, all concentric and in the same plane, and spread uniformly inward and outward from the position of the original coil, the radii of the two coils nearest the original position being respectively $r - \frac{d}{n}$ and $r + \frac{d}{n}$, the radii of the coils next to these being $r - \frac{2d}{n}$ and $r + \frac{2d}{n}$, and so on, the radii of the smallest and largest coils being respectively $r - \frac{nd}{n}$ and $r + \frac{nd}{n}$; and let each of the $2n$ coils carry a current equal to $\frac{C}{2n}$. Then if f_1 and f_2 be the forces exerted in the direction $L\,O$ at O by the coils whose radii are $r - \frac{d}{n}$ and $r + \frac{d}{n}$, and if f be the force which would be exerted if the wire and current of the same two coils were brought

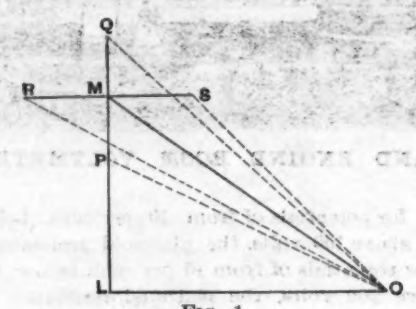


FIG. 1.

into two complete insulated circles in the position of the original one, we get by equation (4)

$$f_1 + f_2 = f\left(1 + A\frac{d^2}{n^2}\right).$$

Similarly, the forces exerted by the next pair of coils, whose radii are respectively $r - \frac{2d}{n}$ and $r + \frac{2d}{n}$, will give us

$$f_3 + f_4 = f\left\{1 + A\left(\frac{2d}{n}\right)^2\right\}$$

and so on, to the smallest and largest coils, which give

$$f_{2n-1} + f_{2n} = f\left\{1 + A\left(\frac{nd}{n}\right)^2\right\}$$

If we denote by F_1 the total force exerted by all the concentric coils, since there are n pairs of them, we shall have, by adding n expressions like the above,

$$F_1 = f\left\{n + \frac{A\,d^2}{n^2}(1 + 2^2 + 3^2 \ldots + n^2)\right\} \qquad (5)$$

Denoting by F the force that would be exerted if the total wire of the $2n$ coils were formed into $2n$ circles coinciding in the position of the original one, each carrying its own current, we should evidently have

$$F = fn, \text{ or } f = \frac{F}{n};$$

and if n is very large we may take

$$1 + 2^2 + 3^2 \ldots + n^2 = \frac{n^3}{3},$$

so that, by substitution, equation (5) may be written

$$F_1 = F\left(1 + \frac{A\,d^2}{3}\right) = F\left\{1 + \frac{d^2}{3}\left(\frac{1}{r^2} - \frac{15e^2}{2(r^2+e^2)^2}\right)\right\} \qquad (6)$$

If then, a current C, in a wire of a single circular turn of infinitely small section, exerts along $L\,O$ the force F at a point on the axis of the circle, the same current uniformly distributed in the section of a wire flattened out, as it were, in its plane, till the section has the radial depth $2d$, with the mean radius unchanged, and d being small compared to r, will exert the force F_1 given by equation (6).

We may proceed in a similar way to find the force that would be exerted if the current, instead of being spread out radially, were distributed uniformly from the original position to a width of $2b$ along the surface of a cylinder having a radius equal to that of the original coil, and extending equally on both sides of the original position, as represented by the section $R\,S$ in the figure. We begin by supposing the original coil at M to be replaced by two coils, at R and S respectively, of the same radius r, each carrying a current $\frac{C}{2}$, the distances of the planes of these coils from the magnet pole O being respectively $e + b$ and $e - b$. In equation (1) in place of e put $e - b$, and again $e + b$; add the two resulting expressions, rearrange the partial denominators so as to take out the factor $(e^2 + r^2)^{\frac{3}{2}}$, assume that b is small compared to r, expand the denominators as before, to three terms each, by the binomial formula, reduce to a common denominator, rejecting negligible terms and simplifying, the sum is found to be

$$\frac{2\pi r^2 C}{(r^2+e^2)^{\frac{3}{2}}}\left\{\frac{1 + \frac{3b^2}{2(r^2+e^2)} + \frac{3b^2e^2}{2(r^2+e^2)^2}}{1 + \frac{3b^2}{r^2+e^2} - \frac{6b^2e^2}{(r^2+e^2)^2}}\right\}$$

This may be further simplified by the same method that was used in getting equations (3) and (4) from (2). Then by writing, as before, a series of expressions for n pairs of coils, and making a summation by noticing that the passage from equation (3) to (6) merely divides by 3 the quantity after the unit in the large brace of equation (3), and denoting by F_2 the resulting value of the force, we find

$$F_2 = F\left\{1 + \frac{b^2(4e^2 - r^2)}{2(r^2+e^2)^2}\right\} \qquad (7)$$

which gives the force at O along $L\,O$ due to a current uniformly spread and flowing around the cylindrical surface whose section is $R\,S$, small compared to r; where F is the force that the same total current would exert if flowing in the wire of infinitely small section passing through M.

If, finally, we suppose the original coil to be first flattened out till the radial depth of the section is $2d$, and then this flat ring to be expanded axially or both ways from the mean plane to a total width of $2b$, b and d being small compared to r, the current C uniformly distributed in the section $2b \times 2d$ will, as we see by putting in place of F in equation (7) the value of F_1 from equation (6), exert a force denoted, say by F_3 equal to

$$F_3 = F\left\{1 + \frac{d^2}{3}\left(\frac{1}{r^2} - \frac{15e^2}{2(r^2+e^2)^2}\right)\right\}$$
$$\left\{1 + \frac{b^2(4e^2 - r^2)}{2(r^2+e^2)^2}\right\}$$

and this by a final approximation may be written

$$F_3 = F\left\{1 + \frac{d^2}{3}\left(\frac{1}{r^2} - \frac{15e^2}{2(r^2+e^2)^2}\right) + \frac{b^2(4e^2 - r^2)}{2(r^2+e^2)^2}\right\} \qquad (8)$$

Allowing for the change of notation, the factor in the large brace of (8) is the same as the corresponding factor G_1 given by Maxwell in his Art. 700.

Observe now that the quantity in the large brace of (8) is a factor by which if we multiply the *force* that would be exerted by a current in a coil of infinitely small section, and radius r, we get the *force* due to a uniformly distributed current in a coil whose section has a depth $2d$ and a breadth $2b$, both small compared to r, the total current across the section remaining unchanged, r being the mean radius and e the distance of the mean plane of the coil from the unit magnet pole.

Equation (1) applies to a coil of only a single turn; but if a coil have N turns in a section so small as to be neglected, each turn carrying the current C, the only change necessary is to multiply the right-hand member of (1) by N. Doing that and changing the form of the equation, it becomes

$$C = \frac{F(r^2+e^2)^{\frac{3}{2}}}{2\pi N r_2} \qquad (9)$$

Now if α be the angle of deflection from the meridian

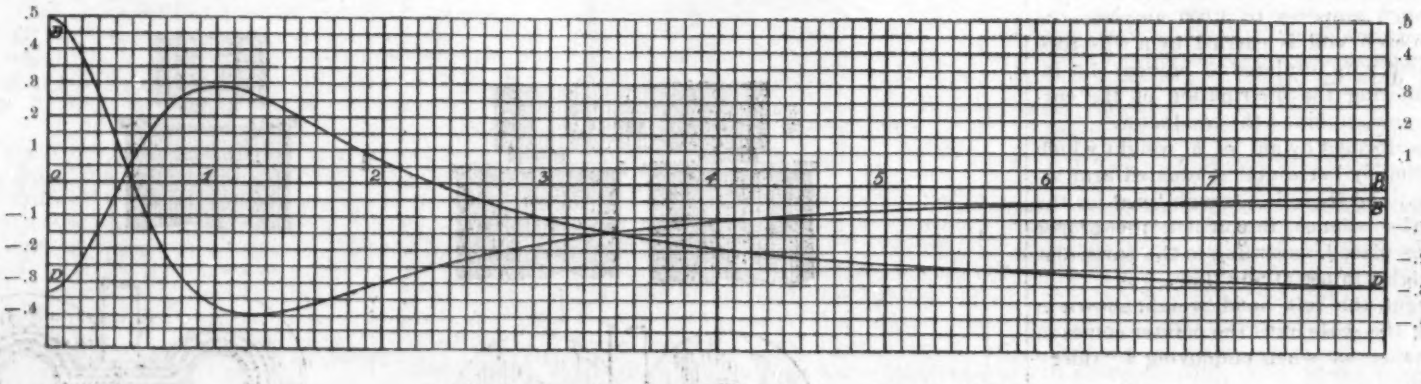


FIG. 2.—GALVANOMETER COIL CORRECTION.

produced in a short needle at O by the force F_3 due to a coil of N turns and a section $2b \times 2d$, if H be the horizontal intensity of the earth's magnetism, and if we for a moment represent the multiplier of F in equation (8) by Q, we shall have

$$F_3 = F\,Q = H\tan\alpha$$
$$\therefore F = \frac{H\tan\alpha}{Q}$$

Substituting this value of F in equation (9), it becomes

$$C = \frac{H\tan\alpha\,(r^2+e^2)^{\frac{3}{2}}}{2\pi N r^2 Q}$$

And now again, by the principle that when x is a small fraction, $1 - x$ may be written for $\frac{1}{1+x}$, after putting into this equation the value of Q we may change the expression to the form

$$C = \frac{H\tan\alpha\,(r^2+e^2)^{\frac{3}{2}}}{2\pi N r^2}\left\{1 + \frac{b^2(r^2-4e^2)}{2(r^2+e^2)^2} + \frac{d^2}{3}\left(\frac{15e^2}{2(r^2+e^2)^2} - \frac{1}{r^2}\right)\right\} \qquad (10)$$

which gives the corrected *current* in the coil, of section $2b \times 2d$. The factor in the brace is what I set out to deduce.

The curves corresponding to the terms depending on b, d, and e may occasionally be useful to those who are comparing the action of coils. If we express the distance e in

* Presented at a meeting of the Am. Acad. of Arts and Sciences, Boston, May 11, 1887, and revised for THE ELECTRICAL WORLD.

terms of r, that is, let $e = r\,x$, we may write the term of (10) that contains b in the form

$$\frac{b^2}{r^2} \times \frac{1 - 4\,x^2}{2\,(1 \times x^2)^2}$$

and the term that contains d in the form

$$\frac{d^2}{r^2} \times \left(\frac{5\,x^2}{2\,(1 \times x^2)^2} - \frac{1}{3} \right)$$

The curve B is constructed by taking values of $x = \frac{e}{r}$ as abscissæ and computing the corresponding values of $\frac{1 - 4\,x^2}{2\,(1 + x^2)^{2.5}}$ which are laid off as ordinates, and similarly the curve D is drawn with ordinates equal to different values of $\frac{5\,x^2}{2\,(1 \times x^2)^2} - \frac{1}{3}$.

To use the curves for the practical correction of current observations, with a given value of $\frac{e}{r}$ as abscissa, multiply the corresponding ordinate of the curve B by $\frac{b^2}{r^2}$ to get the term of correction depending on the breadth of the coil section, and multiply the corresponding ordinate of the curve D by $\frac{d^2}{r^2}$ to get the term of correction depending on the depth of the coil section, remembering that the breadth of the coil section $= 2\,b$ and the depth $= 2\,d$. I have only used positive values of $\frac{e}{r}$, as negative values give the same values of the ordinates.

A simple application of the calculus shows that the curve of breadth correction B has a maximum ordinate when $x = \frac{e}{r} =$, the 0 breadth correction term then being $\frac{1}{4}\frac{b^2}{r^2}$. It has an algebraic minimum when $\frac{e}{r} = \frac{\sqrt{6}}{2} = 1.225$, the correction term then being $-\frac{2\,b^2}{5\,r^2}$. The ordinate is 0 when $\frac{e}{r} = \frac{1}{2}$, and also when $\frac{e}{r} = \infty$. The curve has two points of inflection, given by $\frac{e}{r} = \frac{1}{2}\sqrt{7 \pm \sqrt{41}} =$ approximately 0.39 or 1.80. The axis of abscissæ is an asymptote.

The curve of depth correction D has two equal algebraic minima, coresponding to $x = 0$ and $x = \infty$, the term of depth correction then being $-\frac{1}{4}\frac{d^2}{r^2}$. It has one maximum, given by $\frac{e}{r} = 1$, the correction term then being $\frac{1}{24}\frac{d^2}{r^2}$. The ordinate is 0 when $\frac{e}{r} = \frac{1}{2}(\sqrt{30} \pm \sqrt{14}) =$ approximately 0.43 or 2.30. The curve has two points of inflection given by $\frac{e^2}{r^2} = \frac{4 \pm \sqrt{13}}{3}$ or $\frac{e}{r} =$ approximately 0.36 or 1.59. A parallel to the axis of abscissæ at a distance below it equal to $\frac{1}{4}$ is an asymptote.

The ordinates of the curves were calculated for every half tenth in the values of $\frac{e}{r}$ up to 1.3, and then for every tenth up to 4; then for 4.2, 4.5, 5, and above that for unit differences in $\frac{e}{r}$.

The curves illustrated being on a small scale, I give below the computed ordinates, for the convenience of those who may wish to draw the curves for themselves:

	Ordinates.			Ordinates.	
Abscissæ.	Curve B.	Curve D.	Abscissæ.	Curve B.	Curve D.
0.00	0.500	—0.333	2.10	—0.284	0.043
0.05	0.493	—0.327	2.20	—0.269	0.021
0.10	0.471	—0.309	2.30	—0.255	0.001
0.15	0.435	—0.279	2.40	—0.241	—0.018
0.20	0.388	—0.240	2.50	—0.228	—0.036
0.25	0.332	—0.195	2.60	—0.216	—0.053
0.30	0.269	—0.144	2.70	—0.205	—0.068
0.35	0.202	—0.090	2.80	—0.194	—0.083
0.40	0.134	—0.036	2.90	—0.184	—0.096
0.45	0.065	0.017	3.00	—0.175	—0.108
0.50	0.000	0.067	3.10	—0.166	—0.120
0.55	—0.065	0.112	3.20	—0.158	—0.131
0.60	—0.119	0.153	3.30	—0.151	—0.141
0.65	—0.171	0.189	3.40	—0.143	—0.150
0.70	—0.216	0.218	3.50	—0.137	—0.159
0.75	—0.256	0.243	3.60	—0.130	—0.167
0.80	—0.290	0.262	3.70	—0.125	—0.175
0.85	—0.319	0.275	3.80	—0.119	—0.182
0.90	—0.342	0.285	3.90	—0.114	—0.189
0.95	—0.361	0.290	4.00	—0.109	—0.195
1.00	—0.375	0.292	4.20	—0.100	—0.206
1.05	—0.386	0.290	4.50	—0.089	—0.221
1.10	—0.393	0.288	5.00	—0.073	—0.241
1.15	—0.398	0.280	6.00	—0.052	—0.268
1.20	—0.400	0.271	7.00	—0.039	—0.284
1.25	—0.400	0.262	8.00	—0.030	—0.295
1.30	—0.398	0.251	9.00	—0.024	—0.303
1.40	—0.390	0.226	10.00	—0.020	—0.309
1.50	—0.379	0.199	11.00	—0.016	—0.313
1.60	—0.365	0.172	12.00	—0.014	—0.316
1.70	—0.349	0.144	13.00	—0.012	—0.319
1.80	—0.333	0.117	14.00	—0.010	—0.321
1.90	—0.316	0.091	15.00	—0.009	—0.322
2.00	—0.300	0.067	20.00	—0.005	—0.327

It is interesting to notice that the breadth and depth corrections tend to neutralize each other for values of $\frac{e}{r}$ up to 2.3, after which the current corrections are both negative. With the value $\frac{e}{r} = \frac{1}{2}$, taken by Gaugain and Helmholtz for their galvanometers, the total correction with ordinary proportions of coil section is extremely small.

The complexity of the curves is due to the fact that they represent the changes in the component of the magnetic action parallel to the axis of the coil; and this component is evidently dependent on the angle subtended at the magnet pole by the radius of the coil, as well as on the total force exerted by each elementary part of the circuit.

The breadth correction at very large distances is negligible, and it might at first thought seem as if the depth coreection should be so too; but the investigation shows that the latter is the same for $\frac{e}{r} = \infty$ as for $\frac{e}{r} = 0$. The conclusion that large values of $\frac{e}{r}$ should give large depth corrections may be understood by referring to the figure, and considering that the force exerted at O by an elementary part of the circuit passing through M is perpendicular to $M\,O$, and hence the component of this force along $O\,L$ is proportional to the sine of the angle $M\,O\,L$. Now, if $O\,L$ is very large in comparison to $L\,M$, small changes in $L\,M$ will not much change the total force exerted at O by an element of the circuit, but will materially change the sine of the angle $M\,O\,L$, and hence change the component of the force along $O\,L$. The conclusion also agrees with the fact that at large distances the magnetic action of a plane circuit is nearly proportional to the product of its area by the strength of the current. The total area inclosed by the two coils having their sections at P and Q, which I first supposed to replace the original coil, would be more than twice the area inclosed by that one coil; so that for large values of $\frac{e}{r}$ the magnetic effect along $L\,O$ of the two coils, each carrying the current $\frac{C}{2}$, would be greater than the effect of the one original coil carrying the current C.

ROGERS LABORATORY OF PHYSICS, March, 1887.

A Report on Wire Gauge.

The committee on Wire Gauge, National Electric Light Association held a regular meeting at the office of the Boston Electric Light Company, 17 State street, Boston, at 3 o'clock on Friday June 10 inst.

On the roll being called a quorum was found, the following gentlemen being present: P. Kielholtz, H. H Eustis, Allan V. Garratt, Marmaduke M. M. Slattery; Mr. Garratt in the chair. The principal business transacted was the adoption of the best authorities to be used in calculating the physical and electrical properties of the gauge, which was adopted at the convention in Philadelphia. After a thorough discussion by the gentlemen present, it was voted to base calculations of resistance on the latest published measurements made by Matthiessen, corrected to 0° centigrade for pure copper. Foot-notes to be appended giving constants for calculating to 75°F., and to copper of 98° purity.

Calculations to be made by Vega's seven-place logarithms, and all of the work to be calculated independently by at least two members of the committee. The tables to be presented at the coming convention in Boston will include the following values: Dimensions—Diameter in millimetres, diameter in inches, area in square millimetres, area in square inches; to be calculated by P. Kielholtz. Weight in kilogrammes per kilometre—kilogrammes per ohm, pounds per 1,000 feet, pounds per ohm; to be calculated by Mr. Garratt. Length—Metres per kilogramme, metres per ohm, feet per pound, feet per ohm; to be calculated by Mr. Eustis. Resistance—Ohms per kilogramme, ohms per metre, ohms per pound, ohms per foot; to be calculated by Mr. Slattery.

Adjourned till the following day, at which time Mr. D. H. Stanley was present. Practical means of carrying the gauge into commercial use were discussed.

The National Electric Light Association.

A meeting of the Executive Committee of the National Electric Light Association was held in Boston last week, when preparations were discussed and arrangements made for the convention to be held in that city. It was decided to hold the meeting at the Parker House on Aug 9. Mr. R. W. Ryan was elected official stenographer of the Association, and it was determined that papers to be presented at the convention must be filed with the Executive Committee one week before the convention meets. The question was discussed as to the necessity of broadening the qualifications of membership, and it was agreed that the matter should be brought up at the August meeting. It was further arranged by the committee that a banquet be given on the evening of 11th August, at the Parker House. After transacting a variety of minor miscellaneous business, the Executive Committee adjourned to meet at 10 A. M., Aug. 5. The indications are that the Boston meeting will be the most largely attended of all.

Aluminum Production.—So valuable is the metal that preparations are being made to carry out the electrolytic operation on a large scale. It will be evident that cheap powder is desirable, and those concerned in the Kleiner process of the electrolytic decomposition of the fused double chloride (cryolite) had acquired the rights over half the falls of the Rhine at Schaffhausen, where it was calculated that 15,000 horse-power could be obtained, sufficient to produce 600,000 pounds of aluminum per annum. This bold scheme has, however, fallen through, owing to the government having declined to allow the power of the falls to be used in this manner, as it was considered that the picturesqueness of the locality would be seriously affected. This decision, which must have carried comfort to the heart of Mr. Ruskin, if he has heard of it, has determined those interested in the process to start a large works in some part of England where cheap coal can be obtained, and to test the process on a comparatively large scale by the employment of steam engines of about 500 horse-power. We wish them all success in their important experiment.—*Scientific News.*

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, June 14, 1887.

A most interesting pamphlet has just been issued by the Excelsior Steam Power Company of this city, licensee under the Daft system for transmission of motive power by electricity. This pamphlet gives some details as to power distribution in New York City. It appears that the first steam power plant here was started as a private venture some 30 years ago at 13 Spruce street, when a small engine and boiler supplied the needs of 2 buildings. As time passed, the plant grew. It fell into the hands of the Excelsior Steam Power Company in 1878, and now under the same management, consists of 3 large Wright engines and 5 boilers developing 800 horse-power, which it distributes to customers by shafts and belting over an area of 4 city blocks. At this stage, the limitations of such work are severely felt, and recourse is had naturally to electricity as a substitute and supplement. The Steam Company has entered into arrangements for the Daft system with the Electric Power Company in this city, and has a steam plant specially designed for electric generating purposes. It furnishes Daft motors from 1 to 25 h. p., and does not sell them but leases them just as telephones are leased. The rates charged are $4 per week for 1 h. p.; $6 for 2 h. p., and $3 for every additional h. p. This includes the current, the use of the machine, supervision and all needful repairs, the only extra charge being a small one for placing the motor to do its work. The motors are already in use in a large number of places ranging from 1 up to 6 h. p., and are used in connection with elevators, ventilating fans, printing presses, shoemaking machinery, leather-stamping machinery, paper-cutting machines, diamond cutters, bookbinding machines, beveling wheels, pumps, jewelers' machinery, plating and polishing machinery, lens grinders, and for other mechanical purposes of a varied character. The electric motor is a veritable jack-of-all-trades, and master of the situation wherever it gets a trial.

The vacuum pump made by Mr. Norman Hubbard, 93 to 97 Pearl street, Brooklyn, is designed especially for electric light purposes. It was described recently in THE ELECTRICAL WORLD, and embodies many excellent features. In incandescent lamp manufacture it saves time, labor and money, and its use is said to insure greater life to the lamps. The Sawyer-Man Company use eight of these pumps and the Thomson-Houston Company four, and more of them have been called for. There are three sizes of standard make, and special sizes are constructed to order.

The Sawyer-Man Company published recently a list of its incandescent plants installed and contracted for up to May, 1887. The showing is certainly a very remarkable one, the list including as it does about 220 installations. Some of the plants are of extensive proportions, such as that at Cleveland, O., of 3,000 lights; Lake View, Ill., 1,200; Bar Harbor, Me., 1,400; New Haven, Conn., 1,200; Fulton, N. Y., 1,000; Woonsocket, R. I., 1,000.

The Mutual Electric Manufacturing Company—which, by the way, has recently come among the bidders for New York city lighting, with an offer of a percentage to the city in return for a franchise—has issued a neat illustrated pamphlet in regard to the Knowles electric light system which it controls, and the Knowles fire-alarm system. You have already, from time to time, given details as to the system. One of the Knowles dynamos, it is stated, has made a run recently for four weeks, 23 hours daily, with perfect ease, smoothness and satisfaction.

The American Electric Manufacturing Company appear quite comfortable and happy in their new offices in the Metropolitan Telephone Building, Cortlandt street. There is now a large staff attending to the business. Col. W. A. Stedman, the treasurer, devotes considerable attention to the combination of gas and electric light interests. Mr. J. H. Stedman is the general agent; and the selling agents are Messrs. G. H. Morse, A. B. Griggs, W. W. Monroe, J. R. Simpson, H. A. Stout and Sowden, Elder & Wright, in Boston.

The new Excelsior plant of 250 arc lights at Harrisburg, Pa., went into operation very successfully on June 1, to the great delight and satisfaction of the citizens.

The demand for the Edison system continues as active as ever. The United Edison Company, 65 Fifth avenue, reports contracts for 75 plants within the last sixty days, approximating 10,000 lights.

The vertical automatic cut-off engines of the New York Safety Steam Power Company's make embody all the valuable features of construction detailed in their horizontal engines, of which I spoke recently, so far as valve gear and the governor are concerned.

This vertical engine is possessed of advantages which recommend it with great force to many industries, especially small electric light plants. It has won its way to universal favor on board the finest screw steamers, where its continuous and rapid working, during long and stormy passages, proves it to be peculiarly fitted to sustain severe labor for long periods. It will be understood that there are two bearings for the crank-shaft, both being cast solid with the column, as are also the cross-head slides. There can be in consequence no derangement of lines and no unequal wear of parts. The bearings are long, and the shafts of large diameter, giving both large area of bearings and strength in excess of any reasonable duty. Side wear in the cylinder, by the piston, is obviated by its vertical position. The piston is hollow, firmly fitted to rod, and furnished with two snap packing rings. These are self-adjusting, tight, and at the same time free in their action. The piston-rod, valve-rod, cross-head pin, etc., are of steel; the crank-pin box is of composition, babbited; the cross-head pin box is also of brass. Drain-cocks are connected to both ends of the cylinder, leading condensation into the base, where all drippings are accumulated and thence carried away by a pipe connection. A critical steam test of every engine is made before it leaves the shop, and the necessary adjustments are carefully made, so that the machine is all ready to run the moment it is placed in position and given steam. The company are prepared to furnish four different sizes of vertical automatic engines.

A new small cutter grinder is being manufactured by E. E. Garvin & Co., 139, 141 and 143 Centre street, New York. It is designed to be fastened to the bench, takes up but little room, and is sufficiently inexpensive to make it practicable to

provide each milling machine with a separate grinder, while its capacity is amply sufficient for all ordinary plain work. The machine will grind mills, cut straight or spiral up to 5-inch diameter, 4 inch face, straddle mills up to 8 inch diameter, hollow mills, saws, shell reamers, cutters for gear teeth, and all that class of tools usually ground by hand. The spindle and the arbor for mills are each hardened and ground, the latter to standard size, so that the cutters lapped out to standard gauge will fit without shake, which is an important condition in the production of good work. A single hanger countershaft completes the machine, for which electricians can find many uses.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, June 14, 1887.

Prof. Alexander Graham Bell has been in the city and a guest at the Parker House.

Mr. J. W. Duxbury has been appointed Assistant General Manager of the New England Telephone and Telegraph Company. A most judicious selection.

Cleveland, Whitney & Company, bankers and brokers, No. 7 Exchange Place, Boston, are giving their special attention to investment securities, particularly electric light stocks, paying 7 to 10 per cent. net.

Considerable interest is manifesting itself among the electrical fraternity of this section regarding the contemplated organization of an electric club in Boston.

Blodgett Brothers & Co., of Boston, are busily at work on orders for large annunciators, each having combined "hotel guest call" and fire alarm.

At the annual meeting of the Bickford Railway Electric Company (see ELECTRICAL WORLD, June 11), at Portland, Me., June 8, the capital stock was increased to $125,000. The following officers were elected: President, John P. Peabody; treasurer, Wm. H. Gove; secretary, W. O. Chapman; general manager, John H. Bickford.

W. C. Hibbard, of Montreal, Can., was in Boston last week on a few days' visit among his electrical friends and acquaintances. Mr. Hibbard is manufacturing electrical apparatus and supplies of all kinds, and makes a specialty of insulated wires and cables of every size and description.

The Boston & Albany R. R. Company is having eighteen additional cars wired and equipped for using incandescent electric lights as illuminants. Blodgett Brothers & Company have the work in hand. The same firm are also wiring several cars for incandescent lighting, to be used on the Connecticut River Railroad.

An arc light of 1,200 candle-power will be suspended over Main street, Watertown, Mass., some night this week by the Newton Electric Light and Power Company as a free exhibition. The company has obtained the right, granted originally to David Flanders, of Watertown, to set poles and wires for electric lighting in the principal streets of the town. The selectmen have received a proposition from the company to furnish the arc lights at 50 cents per night, and the incandescent lights, 24 candle-power, at $15 per year. The town pays the gas company $15 per year for 16-candle gas lights, the price having been recently reduced over $2 per light.

The New Haven (Conn.) Electric Light Company has about completed its new station (79 × 170 feet) adjoining and forming a part of the company's old plant. The dynamo, engine and boiler rooms are on same floor. Eighteen dynamos of the Thomson-Houston make (14 arc-light and 4 incandescent machines) form part of the equipment of the station. The ten engines on hand were manufactured by the Armington & Sims Company, Providence, R. I. The five large boilers in use are of the Bigelow type and are set with the Jarvis furnace. The present lighting capacity of the station is 475 arcs and 1,500 incandescents. The president of the company, Mr. English, was in Boston last Saturday.

On a recent visit made by the writer to the works of the Eastern Electric Cable Company, Hampshire street, Boston, a scene of activity really refreshing was witnessed. A large force of men and boys were busily engaged in getting ready for shipment enormous quantities of wire and cables. Some of this product is for foreign customers, while a large part of it is for home use. "During the past week orders have been filled," reported Mr. Henry A. Clark, the general manager, "for upward of 25,000 pounds of my company's insulated wires and cables, and in about two weeks we will have about 20,000 pounds more of our wires and cables ready for shipment abroad and to various sections of this country." The wires and cables referred to are covered with the "Clark Insulation." Some are for aerial use, while others are to be placed underground, or inside of walls freshly plastered, and again some of the larger cables are for submarine purposes. Mr. Clark, assisted by his electrician, H. H. Eustis, gives the various departments personal supervision; and the various stages in the construction of the wires and cables are constantly under the eyes of these gentlemen.

Thomas B. Adams & Co., of 31 Federal street, manufacturers of oak tanned leather belting, are making several belts for the Thomson-Houston Company to go to Waterville, Me., and have just finished the order for the belting used in the new plant at Oneida, N. Y.

Messrs. Paine & Francis, New England agents of the Edison United Manufacturing Company, have closed an order for furnishing two 250 light Edison machines for domestic incandescent lighting and one Edison 160 light municipal dynamo for street lighting for the new electric light station to be erected at the "Kellogg Terrace," Great Barrington, Mass. This increases the lighting capacity of that station to about one thousand lights. These lights are to be used in and around "Kellogg Terrace," and also for lighting the stores, houses and streets of the town above named. The Jarvis Engineering Company will construct and equip the steam plant. Messrs. Paine & Francis have also just made the noteworthy sale of two 500-light Edison machines to the Fall Mountain Paper Company, Bellows Falls, Vt. About three years ago they furnished the same company with 600 incandescent lights (Edison) for use in and about their mills, and also for use in adjacent manufacturing establishments located in what is termed the "Hollow." The recent increase alluded to above is to be devoted to lighting the stores and dwellings in the town of Bellows Falls. The New England Wiring and Construction Company of Boston will have charge of the wiring work.

The laying of the Edison underground three-wire system, Boston, undertaken last fall and interrupted by the approach of winter after about three-quarters of the work had been completed, is now being pushed forward, a large force of laborers working night and day upon the same. The tests made upon the cable laid last fall have been remade, and prove the work to be in excellent condition. Three sections of the underground are already in use, and the entire overhead system, this being retained pending the completion of the underground work. Twelve of the 400-ampère dynamos are in place and running, and the temporary cables to same are being replaced by an elaborate arrangement of conductors upon a new system to be tried at this station, which, it is claimed, will effect a great saving in copper over the present methods, besides having other advantages.

It is interesting to note that the new Edison station was started up and the heavy load of lamps and motors thrown upon it from the old station next door without interrupting the burning of a light or the running of a motor, although this elaborate change necessitated the tearing out of the entire system of "buss," "feeder" and "dynamo" circuits, indicating instruments, as well as changes in the main steam lines, etc.

In the old station building, four Whittier single return steel tubular boilers have been set, in addition to the three formerly in use, and these will eventually be supplemented by seven more. On the floor above a new 500 horse-power National heater has been set up, and the new stock is being built.

Parts of the old building are now occupied by the representatives of the Noll Wiring Company, and the J. H. Rennie Wiring Company, who with the New England Wiring & Construction Company are doing construction work in the first and second districts of the company, under the supervision of the Edison Illuminating Company. The first named company is just completing the wiring of the Hollis Street Theatre with 915 Edison lamps, nearly all of which are already in use, the contract for this work having been awarded them by the Edison Company.

The Edison Electric Illuminating Company has placed 707 lights in the Bijou Theatre, 600 in the Globe Theatre, 915 in the Hollis Street Theatre, 100 in the Park Theatre, and 50 in the Boston Theatre. The latter two will doubtless be increased before the next season, to the lighting of the entire buildings. The company are also lighting the Gaiety Museum and Horticultural Hall.

The new offices are being handsomely fitted up in the new station. They comprise manager's private office, the meter room, work room, exhibition room, etc., and when completed will make the Boston station one of the most complete in the country.

The plans for station No. 2 in the north end of Boston are finished and work is being commenced upon the new building, which will probably be five or six stories in height, supplied with power, light and heat from the station plant in the lower floors. This, it is hoped, will be in operation by the first of September next. This station, as well as the First District station, will be under the control and management of Mr. Wm. J. Hammer, with the able assistance of Mr. E. W. Godfrey.

On Saturday afternoon, June 11, about thirty gentlemen interested in electricity met in a room at 73 Mason Building, office of *Modern Light and Heat*, to consider the advisability of establishing an Electric Club in Boston. Mr. J. F. Morrison, president of the National Electric Light Association, was called upon to preside over the meeting, and Mr. M. M. M. Slattery, of Woburn, Mass., was elected secretary *pro tem.* Mr. Morrison opened the meeting with a happy address, and offered many valuable suggestions and ideas. It will be remembered that he is president of the Crescent Club, one of the largest organizations of the kind in the whole South. The meeting then being declared open for the transaction of business, a motion was passed for the purpose of drawing up a plan of organization, constitution and by-laws to be submitted at the next meeting, which was fixed for June 21, at the same place. The following gentlemen were then appointed as a committee: Frank Ridlon, A. H. Chapman, B. S. Flanders, W. I. Barker, F. M. Gilley, W. B. Hosmer, H. H. Eustis and R. F. Ross. Immediately after the adjournment of the meeting, the committee above-named elected Frank Ridlon as chairman. Sub-committees were then appointed to draft and send out invitations to those gentlemen who had been accidentally overlooked when the previous notices were circulated; to frame the constitution, by-laws and form of organization, and to ascertain the eligibility of applications for membership. Mr. A. V. Garratt was requested to join the committee on constitution and by-laws, and consented to do so. Mr. Ridlon was then appointed *ex officio* chairman of all the sub-committees. It was then decided to adjourn until Tuesday evening, June 13, when the committee meets again at the Parker House to further its work.

Last Monday a controlling interest in the Lynn' Electric Light Company was purchased, says the *Manufacturers Gazette*, by gentlemen in that city who are also interested in the Thomson-Houston Company and the Lynn Gas Light Company. The intention is to further develop the plant and continue the excellent lighting service which has been given in the past. The question of furnishing electric power will receive early attention.

W. I. B.

PHILADELPHIA NOTES.

PHILADELPHIA, Pa., June 13, 1887.

Matters in the electrical field are having considerable of a boom during what is usually called "the dull season" in this vicinity, although it is anything but dull this year.

The idea of a resident at Cape May in having a small motor as the propelling power for a sixteen-foot pleasure boat is likely to develop a new industry, as no less than six of these motors have been turned out by the La Roche Manufacturing Company since the first order was received from Cape May. They are supplied with current by twelve cells of primary battery. It is said that these are the first motors applied to such use wherein a primary battery furnished the power, and will be quite a novelty at the seashore.

Vickers and Weston's Kensington hosiery mill has been supplied with a 300 light incandescent plant of the La Roche system. It is greatly appreciated by the employés. Several other large mill owners in that vicinity are said to be contemplating the introduction of isolated electric light plants in their establishments.

Vallee Brothers & Co. have been obliged to devote themselves almost entirely to the manufacturing department of their business, and are soliciting very little construction work. They are at present turning out large numbers of a new door burglar alarm of their own design. It is a marvel of simplicity and cheapness.

Mr. George W. Lord, the manufacturer of the well-known boiler compound, has evidently come to the conclusion that "all work and no play" is not quite the correct thing for a man abundantly successful in business, as he has had constructed for his enjoyment as trim a little vessel as ever floated the water. The "Lulu May Lord," as the yacht is named, after Mr. Lord's daughter, is sloop-rigged and fitted up in a much more elaborate manner than general with yachts of her size. She is 40 feet keel and 12 feet in breadth and has a depth of 7 feet. The interior fittings are all of hard woods, cherry, walnut and ash being worked together with good effect. She has eight berths and a stateroom for the accommodation of two, all of which are fitted with swinging beds, much after the system of Pullman sleepers, and the sumptuousness of the interior of the little craft can be well compared in comfort to that of those great overland carriages.

The Underground Electric Light and Power Company, which supplies a large number of the stores along Chestnut street with big arc lights, this week notified its customers that after the 15th inst. those lights would be discontinued and incandescent would be used. Superintendent Walter F. Smith, of the company, states that it was simply a matter of business, and that the change had been made because it was thought the incandescent lights would be more profitable. They will be charged for by the month, whether used or not. The company has been making an investigation of the explosion in its conduit on Chestnut street on Decoration Day, and has found that the gas which caused it came from a leaking main. In view of the danger from this cause, Chief Walker, of the Electrical Bureau, has requested the Brush Company to remove its arc light cables from underground conduits, and other companies will probably be asked to do the same. Most of the underground conduits are now owned by the Standard Oil Company people, and it is said that the Brush Electric Light Company, the Thomson-Houston Electric Light Company and the United States Electric Light Company have formed a combination with them to control all the electric lighting in the city. The new arrangement will not go into effect before January next.

A dispatch from West Chester states that at the last regular meeting of the Edison Electric Illuminating Company of West Chester it was determined to purchase a number of electric motors and put them into places where customers seem particularly desirous of trying them. As soon as they are in place and ready to go a part of the machinery at the electric-light station will be run all day as well as at night, in order to furnish the power, the indications being that enough motors can be placed to make it pay the company to establish the system.

An opinion was delivered by Judge Gordon yesterday refusing the petition of John G. Sterrett for a mandamus to compel the Electric Reporting Company to furnish his "bucket shop" with a stock ticker. After alluding to the fact admitted that no legitimate business in stock dealing is transacted by the petitioner, the judge said: The writ of mandamus is not a matter of right, but its issue is for the sound discretion of the Court. Equity will never grant relief where the object sought to be attained is an immoral one, or of pernicious or immoral tendency, or against public policy. Stock gambling being of this character it follows that to grant the petitioner the relief he asks would be to give judicial aid and protection to an admittedly pernicious and unlawful business. Courts of equity are not established for any such purpose, and before they can be successfully invoked to aid the accomplishment of such ends, the fundamental maxims of equity jurisprudence will have to be blotted from our law. As for the reasons stated, the mandamus asked for in this case must be refused. It is unnecessary to consider the other questions raised by the demurrer. The mandamus is refused and the petition dismissed at the cost of the petitioner. E.

PENNSYLVANIA NOTES.

HARRISBURG, Pa., June 11, 1887.

Quite a sensation was caused here on the night of the 1st inst., when the Excelsior Electric Light Company turned on about 250 arc lights. The plant is now working quite satisfactorily, and the lights are very much admired.

Mr. John J. Beggs, lately connected with the Edison Company here, has been seriously ill for the last few weeks. His life was despaired of for some time. He is now in a fair way toward full recovery.

We are expecting to have an electric railway in operation here running from Harrisburg to Steelton, a suburban town about three miles out. The line will be about 3½ miles long.

The Keystone Electric Works are doing a large amount of electrical business in this section and in surrounding towns, paying special attention to hotels and private houses. The works undertake to fit up bells, burglar alarm systems, and private line telephones.

Harrisburg is sometimes called slow, but one way and the other it is getting its share of electrical work.

READING, Pa., June 10, 1887.

Electrical matters are quite brisk in Reading. Mr. Spang, of the Ball electric light system, is putting in a vertical boiler and a 35 horse-power Armington-Sims engine. He has, it is said, secured lately some very valuable motor patents, and this may be one reason why he is enlarging his works. There has been quite a sensation over gas matters in this quarter. The local Edison Company have put in a large number of lights, but the gas people made up their minds not to get left, and so, it is alleged, they just "fixed the bills." Then came a big bowl. My own bill in a small house was $16.38. That just knocked me out, as I am not quite in the front millionaire rank. I now burn democratic oil, being unfortunately too far away from the Edison wires to be

served by them. Many other people have also boycotted the meter. The charge is $2.10 per thousand for the water gas, and it is said they make it at the cost of 16 cents a thousand. There is a wide margin here and abundant food for reflection.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, June 11, 1887.

Up to the present time the Scranton Suburban Railway Company, of Scranton, Pa., have been running only three cars on their electric street railway. The results, however, have been so satisfactory and the citizens of that enterprising town so well pleased with their electric road, that the company determined, some time ago, to extend the plant. They therefore contracted with the Van Depoele Electric Manufacturing Company, of Chicago (whose system they had been using), to furnish them with two 100 h. p. generators. One of these generators is already completed and will be shipped to Scranton early in the coming week, and the other will be forwarded a little later. These generators will furnish power to drive seven cars at present, the cars being equipped as follows: Three cars with 15 h. p. motors, two with 20 h. p. motors and the remaining cars with motors of 25 h. p. each. I understand that quite a number of Scranton citizens have received from parties in other cities letters of inquiry in reference to their electric railway, and in every case have returned favorable answers. This speaks well for the Van Depoele system.

The electric street railway at Lima, O., will start up June 15, with five cars. This road is also equipped with Van Depoele motors.

Following the project to light the Chicago River by electricity, there is now some talk of lighting the whole of Chicago by the same means. Professor Barrett says fifteen electric plants, costing $45,000 each, would be sufficient to light the entire city with electricity. The cost of lighting the city with gas in 1885 was $604,651.42, and he says that in two years would pay for the electric plants and after that time the city could be lighted at 45 per cent. of the present price. "Chicago," he says, "owns her own police stations and fire apparatus. Why should she not own her plant for producing light?"

Mr. C. M. Barclay, the Western agent for the Sprague Company, with offices at 185 Dearborn street, this city, is able to report a very large number of orders for motors, and calls attention to the merits of electric power in some very forcible and plain-spoken circulars. Such clean-cut statements, precise as to figures and entirely free from "bunkum," cannot but have a good effect, and it is no wonder that Mr. Barclay can report orders for over 200 motors.

Mr. J. L. Barclay, brother of the gentleman above named, is developing the western business of Holmes, Booth & Haydens very rapidly. His quickness, ability and unmistakable intention of "getting there every time" have caused him to make his mark already in this centre of drive, bustle and push, where one must at least keep up with the procession or be run over. Mr. Barclay finds business everywhere in good shape, and speaks hopefully of the outlook.

Mr. W. S. Andrews, formerly chief electrical engineer of the Edison Company, is now general superintendent of the Marr Construction Company, with headquarters at Columbus, O. Mr. F. S. Marr, of the above company, is now in Chicago, conferring with parties in reference to the Chicago Edison Company's large central station.

Mr. Francis R. Upton, of the Edison Lamp Company, is in Chicago this week. He is here in the interests of his company.

The Western Department of the Edison Light Company, Humbird & Gorton managers, have closed a contract for a 1,600-light central station at Sioux City, Dak.

The Chicago Electric Club held a meeting last Thursday evening. Gen. A. K. Stiles was in the chair, and there was a large and enthusiastic attendance. It was decided to have a social meeting and dinner on Saturday evening, June 18, 1887, at the Grand Pacific Hotel. Mr. E. H. Johnson, of New York, president of the Edison Light Company, and Mr. T. A. Edison, have been elected honorary members of the club.

Messrs. Leonard & Izard, electrical engineers, have made the following contracts for electric light installations: Sioux Falls central station plant, 500 lights; Sioux Falls Penitentiary, 200; Shattuc Schools, Faribault, Minn., 600; street lighting system at Olney, Ill., 70 32 c. p. lights; Anglo-American Packing and Provision Company, Omaha, 250 lights; Paris, Ill., central station, 500 lights.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me the following telephone stock quotations:

Bell of Mo.	$155@$157
Central Union	48@ 49
Chicago	385@ 400
Colorado	20@ 22
Cumberland	80@ 85
Great Southern	30@ 33
Michigan	76@ 77
Rocky Mountain Bell	40@ 45
Wisconsin	105@ 107

DAYTON, O., June 14, 1887.

The Edison central station at this place, built by the F. S. Marr Company, contractors, for the Dayton Electric Light Company, was completed and put in operation May 27, and since that time has been furnishing light regularly to its many delighted customers, representing at the start about 2,000 16 c. p. lamps, to which additions are being made very rapidly now that the qualities of the light are manifest. The station building is centrally located on Fourth street, and is a substantial brick structure, 110 × 50, built specially for the purpose, containing engine and boiler room and loft. The boiler room is separated from the engine room by a brick wall running to the roof. In the boiler room are three tubular steel boilers, 72 inches by 16 feet, built by E. H. Brownell & Co., of this place. The auxiliaries consist of a duplex steam pump manufactured by Smith, Vail & Co., Dayton, O., a Korting injector, a Barragwanath heater and a Hopps purifier, the latter being necessary owing to the extremely large percentage (29.2 per cent.) of calcium carbonate ($CaCO_3$) contained in the water. The boiler room is designed to contain four more boilers, which will soon be added. In the engine room are four No. 20 Edison dynamos and two high speed engines built by the Taylor Mfg. Co., Chambersburg, Pa. Here, also, provision has been made for three additional engines and six more dynamos, making a total capacity of 8,000 lights.

Mr. H. M. Doubleday, general manager of the Marr Company, supervised personally the construction of the steam plant, which is working to perfection. The Taylor engines especially are much admired by the many visitors. Mr. Thomas Spencer, electrician of the Marr Company, arranged the electical part of the station in his usual admirable way, introducing several new features; among others, a switching device of his own invention, by which the unreliable neutral ampère meter is dispensed with, and the current on either side of the three-wire system is read directly from one main ampère meter. A very simple potential indicator and dynamo switching arrangement, which greatly facilitates turning on and off dynamos in multiple, is another novel feature introduced here. Altogether the plant is about as satisfactory to all concerned as could well be imagined. The officers of the Dayton Company, which also operates an arc light plant, are: president, J. E. Lowes; vice-president, T. S. Babbitt; treasurer, V. Winters; secretary and general manager, J. R. Fletcher.

THE TELEGRAPH.

Mexican Telegraph Company.—The earnings of the Mexican Telegraph and the Central & South American companies for the week ending June 4 were $5,174 and $7,161 respectively. At the annual meeting of the shareholders of the Mexican Telegraph Company last week the following directors were elected for the ensuing year: John E. Alexander, George Blagden, James K. Grace, William G. Hamilton, Edmund L. Baylies, Robert B. Minturn, J. Pierpont Morgan, Alfred Pell, James A. Scrymser. The Central & South American directors elected were Edward D. Adams, Michael P. Grace, William G. Hamilton, J. Pierpont Morgan, Alfred Pell, Theodore J. Desabla, James A. Scrymser, James M. Munoz and Charles Lamar.

THE TELEPHONE.

Bell Dividend.—The directors have declared a regular quarterly dividend of 3 per cent., payable July 15.

The Government Suit.—The proceedings in the Boston suit of the government against the American Bell Telephone Company began on June 13, before Judges Colt and Nelson.

Washington Gossip.—A special dispatch from Washington, of June 12, says: "A statement was published here to-day claiming to give the standing of the United States Supreme Court on the telephone cases as 4 to 2 against Bell. This is, of course, without authority."

Erie Telephone.—A telegram of June 7 from Lowell says: One of the directors of the Erie Telephone Company said to-night that the rumor of 2,000 shares of treasury stock being offered for sale was not correct. The matter has been briefly discussed by the directors individually, but never presented as a proposition to be voted upon in the meeting of the board.

Pittsburgh, Pa.—A fire broke out on the morning of June 10 in the First National Bank building at Pittsburgh, where the telephone exchange and the Western Union main office are located. The damage done before the fire was extinguished was very heavy, reaching, it is said, $35,000 on the part of the Western Union Company and $15,000 to $20,000 on the part of the telephone company.

Venezuela, S. A.—A Washington special of June 8 says that the American Telephone Company is a new enterprise presided over by Congressman Butterworth, and intending to issue $5,000,000 of stock, for the operation of telephones in Venezuela. Mr. Butterworth should know that the Intercontinental Telephone Company of Boston, H. S. Russell president, holds an exclusive concession granted by Gen. Guzman Blanco, June 11, 1883, and confirmed by the Venezuela Congress, as published in the Official Gazette No. 3,094 of Nov. 5, 1883. This company also owns the rights of Prof. Alexander Graham Bell and Francis Blake, and is the sole export agent of the American Bell Telephone Company. It has exchanges in the cities of Caracas and La Guayra, Valencia and Porto Cabello, aggregating over 700 subscribers.

THE ELECTRIC LIGHT.

Monson, Mass.—Mr. J. F. Heery is interested in a movement to establish a plant at Monson.

Stafford Springs, Conn.—The Stafford Springs Electric Light and Gas Company is a recent incorporation.

Florence, Wis.—Mr. A. K. Godsball is prepared to enter into negotiations for a plant to be erected at Florence.

Paterson, N. J.—The American Company, of New York, has contracted to light Paterson, N. J., for 38 cents per lamp per night.

Farmington, Me.—An electric light company is being formed at Farmington. It will start off with a 500-light incandescent plant.

Denver, Col.—The Westinghouse plant contracted for by Denver parties will consist of 6,500 lights, to be operated from five dynamos.

Warsaw, Ill.—The Warsaw Electric Light Company has been incorporated by G. P. Walker and others with a capital stock of $3,000.

Dexter, Wis.—The Dexter Electric Light and Power Company has been formed by S. S. Ireland and others with a capital stock of $10,000.

Greenville, Miss.—The Greenville Gas and Electric Light Company has been organized by F. L. Bates, J. E. Negus, J. Burke and others.

Parkersburgh, W. Va.—The Parkersburgh Electric Light Company, Parkersburgh, W. Va., have installed 1,300 lights on the alternating system, their steam plant consisting of two 60 horse-power Westinghouse engines. In adopting the alternating system, they were governed largely by the fact that they were able to locate their plant on the outskirts of the town, instead of, as originally proposed, in the centre of the business district.

Brooklyn, N. Y.—It is said that prosecutions, resulting from the recent electric light and municipal investigations, will begin next week.

The Eickemeyer Dynamo Machine Company has been incorporated, with a capital stock of $60,000, by Rudolph Eickemeyer, of Yonkers, and others.

Birmingham, Ala.—The Birmingham Gas and Electric Light Company has been incorporated by J. T. B. Jackson and others with a capital stock of $500,000.

Boston, Mass.—The Boston Electric Light Company has acquired control of the Citizens' Electric Light Company of East Boston, and took possession more than a week ago.

Madison, Wis.—The Columbia Electric Gas Light Company, of Madison, has been incorporated with a capital of $100,000 by R. J. Thomas, W. L. Jones, F. Oakley and others.

Plainfield, N. J.—The Plainfield Electric Light Company has nearly completed the enlargement of its station to a capacity of 3,000 lights on the Westinghouse alternating system.

Mather Works, Manchester, Conn.—The Harrison Safety Boiler Works, Philadelphia, Pa., have shipped two 75 horse-power boilers to the Mather Electric Company, of Hartford, for its new works at Manchester.

Canada.—It is reported that the American Company will establish a branch factory in Canada, and that some of the Canadian gas companies proposing to use electric lights will be interested in the enterprise.

Berlin, Germany.—A Berlin corporation has entered into a contract to light with electricity the whole of the street Unter-den-Linden for five years at 20,000 marks yearly. One hundred and twenty-six arc lights are to be used.

New York State.—Mr. E. G. Bernard, the agent of the Sawyer-Man Company, has just sold a 150 light plant to the Mohawk Knitting Company, Mohawk, N. Y., and a 75 light plant to J. A. Hover, for his knitting mill at Stockport, N. Y.

New York Franchises.—The resolutions of the Board of Aldermen granting franchises to the Ball, Waterhouse, American, Harlem, North New York, Mount Morris and Mutual Electric Light companies were signed by Mayor Hewitt on June 13.

New York City.—The Mutual Electric Illuminating Company, of New York, has been incorporated by J. G. H. Meyers and others, with a capital stock of $25,000. The Citizens' Freeman Electric Light Company has been incorporated by T. O'Brien and others, with a capital stock of $30,000.

Paris, France.—The municipal council of Paris has adopted a resolution compelling all theatres, cafés and concert halls to substitute electric light for gas. This action is the immediate result of the late disastrous fire at the Opera Comique. These places have been granted three months within which to get their electric lights in operation.

Manitou Springs, Col.—A large arc and incandescent plant is being put up at Manitou Springs by Messrs. C. W. Brown and G. C. T. Hall, for the Thomson-Houston Company. The arc plant will consist of 30 lights, and the incandescent of 500. Three of the largest hotels have already been wired for 350 lights, and it is expected to start this week with 425 lights in circuit.

Pittsfield, Mass.—The Pittsfield Electric Illuminating Company are changing their plant from the direct current system to the Westinghouse alternating system. Their first installment is for 1,300 lights, and they have received the contract for the city lighting for the ensuing year. Lamps of 25 c. p. will be used. They are also preparing to run a line to Lenox, Mass., a distance of six miles, for the purpose of lighting the summer residences in that town.

Oakland, Cal.—Mr. W. W. Slater, the superintendent of the block signal system at the Oak mole, has recently installed a number of incandescent lights for signaling purposes. It was found that the ordinary coal oil lamps with colored shades were continually blowing out, and hence a constant watch was necessary to keep them burning. This involved serious expense and trouble. It is found that the incandescents work admirably, giving 3 times as much light as the oil lamps, and that they necessitate no addition to the plant already in use to supply light for the station.

Forty Alternating Stations.—The Westinghouse Electric Company are meeting, they state, with an enormous demand for their alternating system for central station work. The shops employ about 1,200 men, and are working a night gang, while the lamp factory is claimed to be the largest in the United States. They have now over forty stations under construction or in operation. Recent contracts have been made in Pittsfield and Springfield, Mass.; Hartford, Conn.; Denver, Colorado Springs and Ouray, Col; St. Louis, Mo.; Cornwall, Canada; Littleton, N. H.; Portland, Me.; Morristown, N. J.; Staten Island, N. Y.; Galveston, Tex., and Charleston, W. Va.

Words of Wisdom.—Don't make the too common mistake of thinking a cheap engineer is the man you want. The engine and boiler which furnish the power are important factors in the success of any business, and no matter how simple or strong they may be it will pay to put them in charge of a man fully competent to care for them, and particularly so if far from facilities for quick and proper repairs. For a small plant it is not necessary to have the highest grade of ability—for there are grades among engineers—but it is better to pay a suitable man for competent and faithful service than to pay for what may happen through the incompetence or neglect of one whose only recommendation is that he is "cheap."—*Ex.*

Haverford, Pa.—In reply to many inquiries it may be stated that the Haverford, Pa., Electric Light Company is a sub-company, operating a central station with storage batteries of the Electrical Accumulator Company. It has a 65 h. p. boiler, a 50 h. p. engine, and two dynamos from the Electro-Dynamic Company, of Philadelphia. The station is capable of supplying 3,000 incandescent lamps on circuits aggregating some 10 miles under ground. Lights are now being supplied to customers distributed

over about 5 miles of underground circuit, and owing, it is said, to the use of storage batteries, there has been no failure of light in any instance since the station was started some months ago.

APPLICATIONS OF POWER.

Portland, Ore.—It is reported that Cleveland motors are about to be introduced on a large scale at Portland.

Bellevue, Pa.—An electric railway will be started at Bellevue, operating with a 100 h. p. Westinghouse engine in the power station.

California.—Oakland has a franchise for an electric railway and Alameda wants one, too, so that the two roads can connect and adopt a uniform system.

Ansonia, Conn.—The new Ansonia electric street railway expects to divert some mill freight that has been going to the New Haven & Derby Railroad for the Derby steamboat to New York.

San Diego, Cal.—The electric railway between San Diego City and old San Diego is now in course of construction on the Henry system, and will, it is said, probably be in running order by the 1st July.

The Demand for Motors.—The Sprague Company have over seven hundred motors in process of construction, varying in size from a half h. p up to 30 h. p. The sales last month were nearly two hundred motors, with a capacity of over 1,000 h. p.

Lynn, Mass.—The power for the Lynn Industrial Exhibition is being furnished by the Lynn Electric Lighting Company, 30 h. p. from three electric motors. The exhibition was opened two week ago by Governor Ames, of Massachusetts, who turned on the switch starting the machinery.

Marion, O.—The Marion Street Railroad Company has not yet taken definite shape, but it is expected that it will within a short time construct a line from one to four miles long. The motive power will probably be electric, though it is said that some of the parties interested have unwisdom enough to talk of using "crude petroleum" engines.

Middletown, Conn.—The directors of the horse car railroad company at Middletown have made a contract for the equipment of their line as an electric railway on the Daft system. Four cars will be put in operation at once, and a 60 horse-power dynamo has been ordered for the central station. Overhead conductors will be used. The motors will be placed under the car, suspended between the axles. The cars will be lighted by electricity from the power circuit.

Water-Power for Motors in Maine.—An important enterprise has been undertaken by the Lewiston & Auburn Electric Light Company, in the building of a new stone dam, on the upper power of the Little Androscoggin Water-Power Company. This will give about 500 horse-power, which the company will use for electric motors as well as lights. These motors can be furnished to the smaller industries of the twin cities requiring from one to twenty horse-power at a much less cost than water or steam. They have a ten year' lease, and the dam will cost about $10,000 and be finished the first of November next.

MISCELLANEOUS NOTES.

Electric Fire Extinguishers.—The Kansas Edison Electric Fire Extinguisher Company, Topeka, Kan., has been formed by F. C. Fredericks and others with a capital stock of $50,000.

New York Subways.—There has been considerable anxiety in New York during the past week as to the fate of the Subway Bill now awaiting Governor Hill's signature. At this time of writing, the bill is still unsigned.

Electro Deposition.—The New York Copper Company gave an order last week for a No. 5 dynamo of the Excelsior Electric Company's make for deposition purposes. It is the size next to the largest, and is guaranteed to deposit 2,000 pounds of copper per working day.

Melograph and Melotrope.—A cable dispatch from London, of June 11, gives the following: A very ingenious invention has been successfully experimented with in Paris. Jules Charpentier has made two machines which he calls the melograph and the melotrope. These two little instruments enable a composer to record and to permanently register by electricity the music as it is played on the piano. The melograph records it upon a sheet of paper, and this sheet of paper, when passed to the composer through the melotrope, produces each note and expression of the composer. This was demonstrated most successfully by Saint Saëns.

A German Greeting.—The following is from the *Fortschritt der Zeit*: THE ELECTRICAL WORLD. Diese von Herrn. W. J. Johnston, 168–177 Potter Building, New York, hereausgegebene Wochenschrift ist unbedingt die gediegenste Zeitschrift welche den Fortschritt der Elektricität gewidmet ist. Vor 13 Jahren erschien das Blatt halbmonatlich mit vier kleinen Seiten; gegenwärtig erscheint es wöchentlich mit niemals weniger als 28 grossen Seiten, elegant ausgestattet und durch zahlreiche treffliche Abbildungen die neuesten Erfindingen und Entwickelungen der Elektricität veranschaulichend. Einzelne Nummer kosten 10 cents, der Subscriptionspreis beträgt $3 per Jahr.

New York Subway Suit.—The suit which the New York Electric Lines Company has brought against the Electric Subway Commissioners, the American Consolidated Conduit Company, its contractor, John D. Crimmins, and the Consolidated Telegraph Company was argued in the Superior Court before Judge O'Gorman last week upon a demurrer raised by all the defendants except the last named, which has filed an answer that will be tried in the Superior Court, Special Term, during the month. In this suit the Electric Lines Company asks the court to restrain the defendants from laying down electric subways in the streets of New York upon the ground that its charter granted by the Legislature in 1887 gives it the sole right to do so. The demurrer sets up that the plaintiff has no legal existence, having forfeited its charter by failing to begin work within the time prescribed therein. The plaintiff says that it filed plans of the subways it proposed to build within the prescribed time, and that that was beginning work within the meaning of the charter. Decision reserved.

English Electricians' Jubilee Dinner.—Preparations have been made by the subjoined committee for a dinner on Monday, June 20, to celebrate the jubilee of Queen Victoria's accession and of the establishment of the telegraph in England. It is thought that there are many electricians of English birth, descent or business connections who will gladly avail themselves of the opportunity to unite on such an interesting occasion, and a large number have already assured the committee of their cordial participation. No gathering of the kind has ever been held before in this country, and it is believed that the evening can be spent most agreeably and fraternally. The dinner will take place at Martinelli's Restaurant, 136 Fifth avenue (near Nineteenth street) at 7 P. M. The tickets will cost $2 each (including a pint of claret). The dinner will be followed by speeches and by an amateur musical entertainment, for which special original contributions are promised. The occasion will undoubtedly be one to be long remembered with pleasure. The committee therefore requests any one interested to be kind enough to inform its members at once of their intention to be present and of the number of friends who will accompany them. The Committee of Arrangements consists of George G. Ward, 40 Wall street; Leo Daft, 115 Broadway; Samuel Insull, 40 Wall street; T. C. Martin, 168–175 Potter Building; W. M. Callender, Secretary and Treasurer, Aldrich Building.

PERSONALS.

Mr. J. B. Powell, of the Brush-Swan Company, New York, left this week for Europe on the "Britannic," to be gone a month or two.

Prof. W. A. Anthony, of Cornell University, made an address recently on electrical topics before the Carbondale, Pa., Board of Trade, and a reception was given him at the close.

Mr. I. Irving Courtenay, of the Electric Power Storage Company, London, has recently been on a visit to this country as a guest of the Electrical Accumulator Company of New York. Mr. Courtenay, who is very well informed as to storage battery developments in Europe, and who has used his time to good purpose in making observations here, returned to Europe last week by the steamer "Adriatic."

Mr. C. I. Reilly, formerly manager of the Chicago office the Excelsior Electric Company, of New York, has accepted the position of superintendent electrician of the Excelsior Company of St. Louis. The latter company has just completed a new and handsome central station, from which it anticipates doing an extensive light and power business.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks:

June 14, 1887.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	.....	37
Am. Tel. & Cable	75	76
Cen. & So. Am.	96	100
*Com. Tel	.....	.....
*Gold & Stock	.....	.....
*Inter. Ocean Tel.	.....	.....
N. Y. Mutual	80	81
Pac. & Atl.	48	54
*Postal T. & C.	.....	.....
South. & Atl.	68	75
W. U. Tel.	77	77⅛
W. U. Scrip.	75	.....
W. U. Bonds	117	.....
Mut. U. Bonds	86	86½
TELEPHONE.		
Am. Bell	220	224
Am. Speaking	110	120
Erie	36	36½
*Hudson River	.....	60

TELEPHONE.	Bid.	Asked
Mexican	1⅝	1¾
*N. Y. & N. J.	87	92
N. Y. & Pa.	.....	.....
New England	46	46½
*Southern Bell	125	135
ELECTRIC LIGHT.		
*Am. Electric	.....	.....
*Brush	.....	.....
*Brush Ill.	.....	90
*Consolidated	.....	.....
*Daft	.....	.....
*Edison	237	240
*Edison Ill	98	100
*Edison Isolated	.....	.....
*United States	.....	.....
*U. S. Ill.	.....	.....
MOTOR.		
*Daft	.....	.....
*Sprague	.....	.....

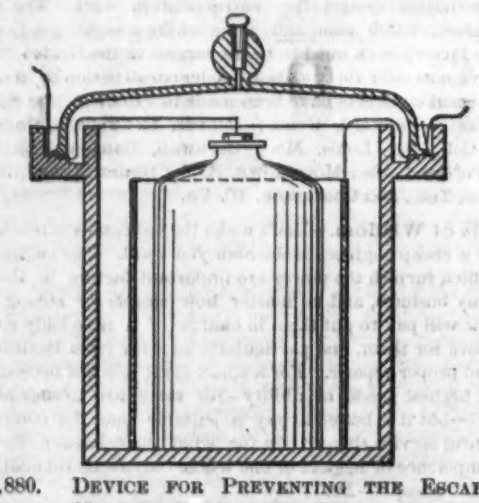
* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MAY 31, 1887.

10,838. Reissue. Electrical Safety Device for Elevators; R. M. Curtiss, of Brooklyn, N. Y. Application filed March 15, 1887. In order to prevent the elevator from moving too far in either direction contact pieces are placed in the path of the car, which, when operated by the car, complete a circuit and stop the engine.

363,851. Induction Coil; J. Ritchie, of Brookline, Mass. Application filed July 30, 1886. A spool for the secondary consisting of a cylinder with heads and with one or more ridges,



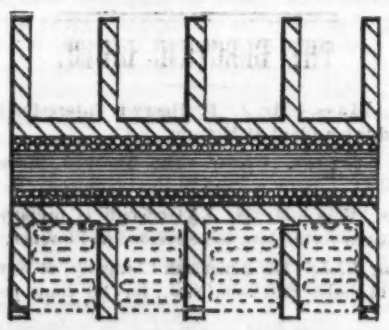
363,880. DEVICE FOR PREVENTING THE ESCAPE OF NOXIOUS FUMES FROM BATTERIES.

of one piece of vulcanite or other suitable insulating material, forming spaces for winding the insulated wire. See illustration.

363,880. Device for Preventing the Escape of Noxious Fumes from Batteries; M. Bailey and J. Warner, of London, Eng. Application filed Dec. 29, 1886. The elements of the battery are inclosed in a bell glass or shade, which dips into the liquid contained in the outer jar. See illustration.

363,886. Electric Belt; W. W. Dunlap, of Oscaloosa, Ia. Application filed Jan. 12, 1887. A novel construction and arrangement of battery and circuits.

363,909. Process of Repairing Incandescent Electric Lamp Filaments; C. Pauthonier, Levallois-Perret (Seine), France. Application filed Dec. 22, 1886. The bulb containing the broken filament is filled with a liquid or gaseous



363,851. INDUCTION COIL.

hydrocarbon; the parts of the fracture are then brought together and a current of electricity passed through, which welds the ends by a deposit of carbon.

363,948. Signal Box; H. A. Chase, of Stoneham, Mass.; Assignor to the Municipal Signal Co., of Portsmouth, N. H. Application filed, Aug. 31, 1886. To prevent plugging of box keyholes without detection, an escutcheon is suspended in front of the hole, and the turning aside of this rings an alarm.

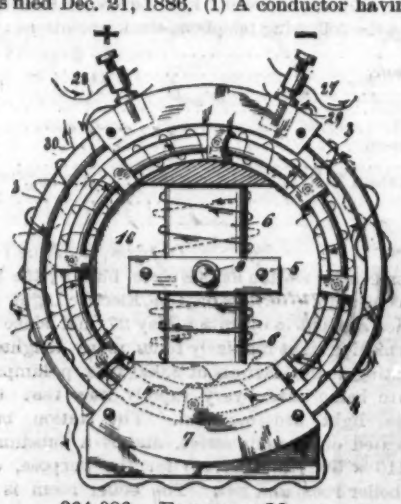
363,969. Multiple Telegraph System; C. Selden, of Baltimore, Md., Assignor to himself, Wm. T. Barnard, of same place, and F. Van Ryselberghe, of Brussels, Belgium. Application filed April 26, 1886. A receiver is constructed and arranged so that it may be operated either in a direct or in a derived circuit, and will also admit of being duplexed or quadruplexed.

364,009. Railway Signals; B. H. Gedge, of Covington, Ky. Application filed Jan. 17, 1887. Structural details designed as improvements on a previous patent.

364,031. Method of Carbonizing Incandescents; W. Maxwell, of Claybrook Road, Fulham, County of Middlsex, Eng. Application filed Sept. 22, 1886. The carbonization is effected by placing the filaments in a mold or casing which is electrically heated within a closed chamber containing a suitable atmosphere.

364,086. Electric Motor; G. F. Card, of Covington, Ky., Assignor to the G. F. Card Manufacturing Co., of same place. Application filed Nov. 29, 1886. Details of construction tending to produce an efficient motor. See illustration.

(1) 364,177. Machine for Making Seamless Lead Covered Electrical Conductors; (2) 364,178. Lead Covered Electrical Conductor or Cable; G. L. Kitson, of Philadelphia, Pa., Assignor, by direct and mesne assignments to the Kitson Electric Co., of Camden, N. J. Applications filed Dec. 21, 1886. (1) A conductor having a fibrous



364,086. ELECTRIC MOTOR.

insulation from which the moisture has been expelled and a covering of lead for the insulation. (2) A machine for putting the lead casing on the above described conductor.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.

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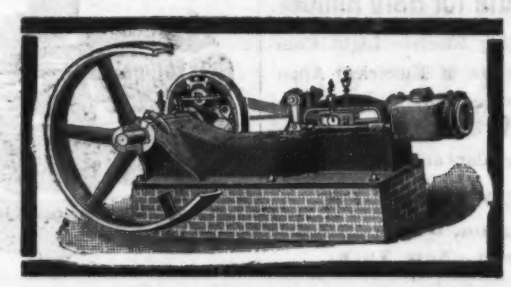

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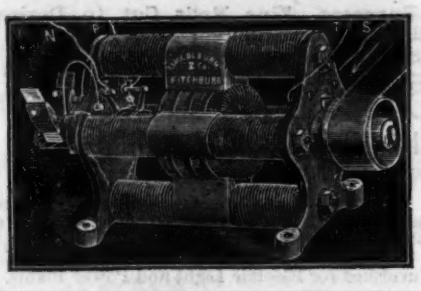

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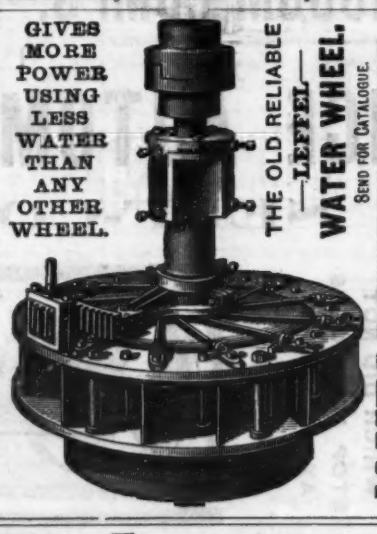

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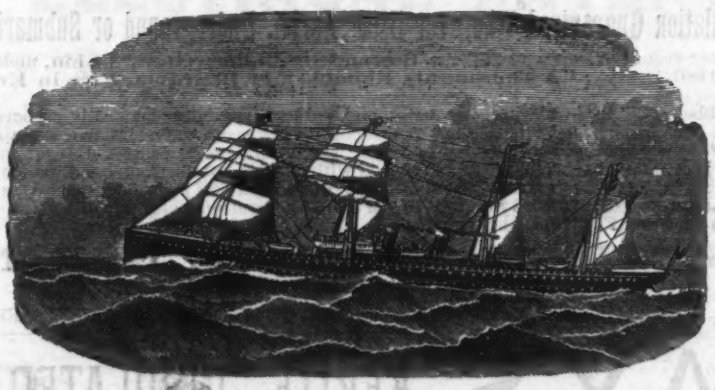

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